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# FM 20-100

WAR DEPARTMENT FIELD MANUAL

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## ARMY GROUND FORCES

## LIGHT AVIATION

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ONLY

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WAR DEPARTMENT • SEPTEMBER 1947

**WAR DEPARTMENT FIELD MANUAL**

**FM 20-100**

*This manual supersedes FM 6-150, 30 August 1944*

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**ARMY GROUND FORCES**

**LIGHT**

**AVIATION**

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**WAR DEPARTMENT • SEPTEMBER 1947**

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*This manual supersedes FM 6-150, 30 August 1944*

## CHAPTER 1

### GENERAL

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**1. PURPOSE AND SCOPE.** This manual is a guide for the military personnel of Army Ground Forces units who are concerned with organic light aviation. It describes the training, tactical employment, administration, maintenance, and supply of Army Ground Forces light aviation.

**2. MISSION.** The missions of Army Ground Forces light aviation are:

- a. Obtaining information on hostile and friendly forces.
- b. Locating appropriate targets.
- c. Adjusting fire.
- d. Maintaining continuous aerial surveillance of enemy forward areas.
- e. Aerial route reconnaissance.
- f. Control of march columns.
- g. Radio relay.
- h. Aerial photography.
- i. Aerial supply in cases of emergency.
- j. Aerial evacuation in cases of emergency.

**NOTE:** For military terms not defined in this manual, see TM 20-205, and for list of training publications, see FM 21-6.

k. Camouflage inspection flights.

l. Messenger service.

m. Courier service.

**3. DEFINITIONS.** Various terms used in this manual are defined as follows:

**a. Army Ground Forces light aviation.** Aircraft organically assigned to Army Ground Forces units together with the personnel and equipment assigned to operate and maintain these aircraft.

**b. Air section.** The Army Ground Forces light aviation organically assigned to a particular unit.

**c. Landing strip.** A piece of land suitable for landings and take-offs by light aircraft.

**d. Landing field.** A landing strip with installations necessary for the operation of the air section.

**e. Pilot.** An Army Ground Forces pilot (1981).

**f. Observer.** The individual who flies with the pilot and assists the pilot in performing aerial missions.

**g. Ground crew.** The mechanics, drivers, and other personnel of the air section who maintain aircraft, drive vehicles, and operate the air field. Normally they do not fly.

**h. Unit commander.** The term "unit commander" designates the commander of a unit having an air section organic to that unit, such as a battalion, squadron, group, regiment, division artillery headquarters, or division headquarters. When other unit commanders are specified they will be designated by their specific titles, such as headquarters battery commander, or headquarters company commander.

**4. ORGANIZATION.** a. **Unit air sections.** Air sections are currently authorized for the following type organizations:

Army, Corps, and Division Headquarters.

Corps Artillery, Field Artillery Brigade, Field Artillery Group, and Division Artillery Headquarters.

Combat Command, and Tank Battalion Headquarters.

Reconnaissance Battalion, Armored Division.

Infantry Regiment Headquarters.

Field Artillery Battalion Headquarters.

Engineer Combat Battalion Headquarters.

Cavalry Group, Mechanized, and Cavalry Reconnaissance Squadron, Mechanized, Headquarters.

Field Operation Company, Signal Battalion.

b. **Unit air officer.** (1) *General.* An air officer of field grade is included on the staff of the commander of each theater, army group, army corps, corps artillery, division, division artillery, field artillery brigade, field artillery group, and cavalry group in order to coordinate policies concerning operation, supply, maintenance, and replacement of Army Ground Forces light aviation equipment and personnel within the command. Although his primary duties are those of a staff officer, he must hold a currently valid liaison pilot rating, be physically qualified for flying duty, and be required by orders to participate regularly and frequently in aerial flights. He has no command functions, but must maintain

continuous liaison with the organic aviation of subordinate units.

(2) *Duties.* The air officer will be prepared to assist the commander and staff by—

(a) Advising, within the command, on all matters pertaining to Army Ground Forces light aviation.

(b) Preparing, coordinating, and supervising plans for training, employing, replacing, and relieving Army Ground Forces light aviation personnel.

(c) Acting as a coordinating agency to insure rapid procurement and distribution of aircraft and aircraft supplies, parts, and equipment.

(d) Supervising and coordinating the selection, preparation, operation, and improvement of landing strips and landing fields.

(e) Inspecting for compliance with applicable regulations and directives concerning the operation and maintenance of aircraft and the maintenance of prescribed forms and records.

c. **Air supply and engineering officer.** In the higher headquarters having organic aviation, a pilot in the grade of captain is provided by Tables of Organization to assist the air officer in the performance of his duties. This captain acts as air supply and engineering officer of the unit headquarters, and estimates well in advance the combat needs for special equipment and supplies.

d. **Regimental or battalion air officer.** The senior pilot assigned to an infantry regiment, artillery battalion, or similar unit having an air section commands this air section and also acts as the unit air officer with duties as outlined b above.

e. Duties of key personnel. The principal duties of key personnel of each air section are as follows:

<i>Individual</i>	<i>Duties</i>
Pilot (1981)	Operates aircraft and supervises aircraft maintenance; assists observer in adjusting fire, reconnaissance and aerial observation; maintains aircraft forms and records; selects and operates landing fields.
Senior army airplane and engine mechanic (747)	Performs airplane maintenance and repairs; prepares and maintains landing fields; assists pilot in reconnaissance for landing strips; assists pilot in completing necessary forms and records; supervises maintenance of vehicles, radios, weapons and all equipment assigned to the air section; supervises the activity of all enlisted personnel assigned or attached to the air section. In group, brigade, divi-

*Individual*

*Duties*

sion artillery, division, corps artillery, and corps the senior mechanic assists the air officer in performing technical inspections of aircraft and maintains a supply of aircraft spare parts and equipment.

Junior army airplane  
and engine  
mechanic (747)

Assists the senior me-  
chanic.

**5. EQUIPMENT.** **a. General.** The equipment of each air section is shown in corresponding Tables of Equipment. In general, the major items are one or two liaison aircraft, radio communication equipment, motor transportation, and weapons for the defense of the landing field.

**b. Characteristics of Army Ground Forces aircraft.** (1) The ability to operate from small unprepared landing strips is the chief requisite for Army Ground Forces aircraft. This requirement necessarily restricts the weight and load-carrying capacity and the speed of the aircraft. The aircraft must require a minimum of maintenance in order to operate dependably under field conditions.

(2) The performance of Army Ground Forces aircraft varies considerably with design. The light, low-powered type, such as the L-4, will operate

from small, relatively unprepared landing strips with a minimum of maintenance. The heavier type, of which the L-5 is an example, has a higher speed and rate of climb as well as greater stability in high winds or turbulent air. If the L-5 type aircraft is employed, longer and harder surfaced landing strips must be made available, aircraft maintenance will be more difficult, and more gasoline will be required. Performance data of each type aircraft may be found in the Army Air Forces Technical Orders pertaining to the aircraft. (See figs. 1 and 2.)

(3) A landing strip 200 yards in length on firm terrain without high obstructions at either end will normally accommodate the L-4 type aircraft. A landing strip 300 yards in length will accommodate the L-5 type aircraft under the same conditions. A longer field must be used under certain conditions of terrain, altitude, and prevailing wind. The pilot is responsible for evaluating these conditions.

**6. AIR TRAFFIC REGULATIONS.** The control of air traffic in the vicinity of the landing field is the responsibility of the unit commander whose air section is operating from the field. Except under tactical or simulated tactical conditions, all extended flights will be conducted in accordance with Army Air Forces Regulations 60-16. In addition, the unit commander must publish and enforce such local air traffic and landing field regulations as are necessary to prevent careless or hazardous flying.

**7. RESPONSIBILITY FOR TRAINING.** The unit commander is responsible for the proper train-

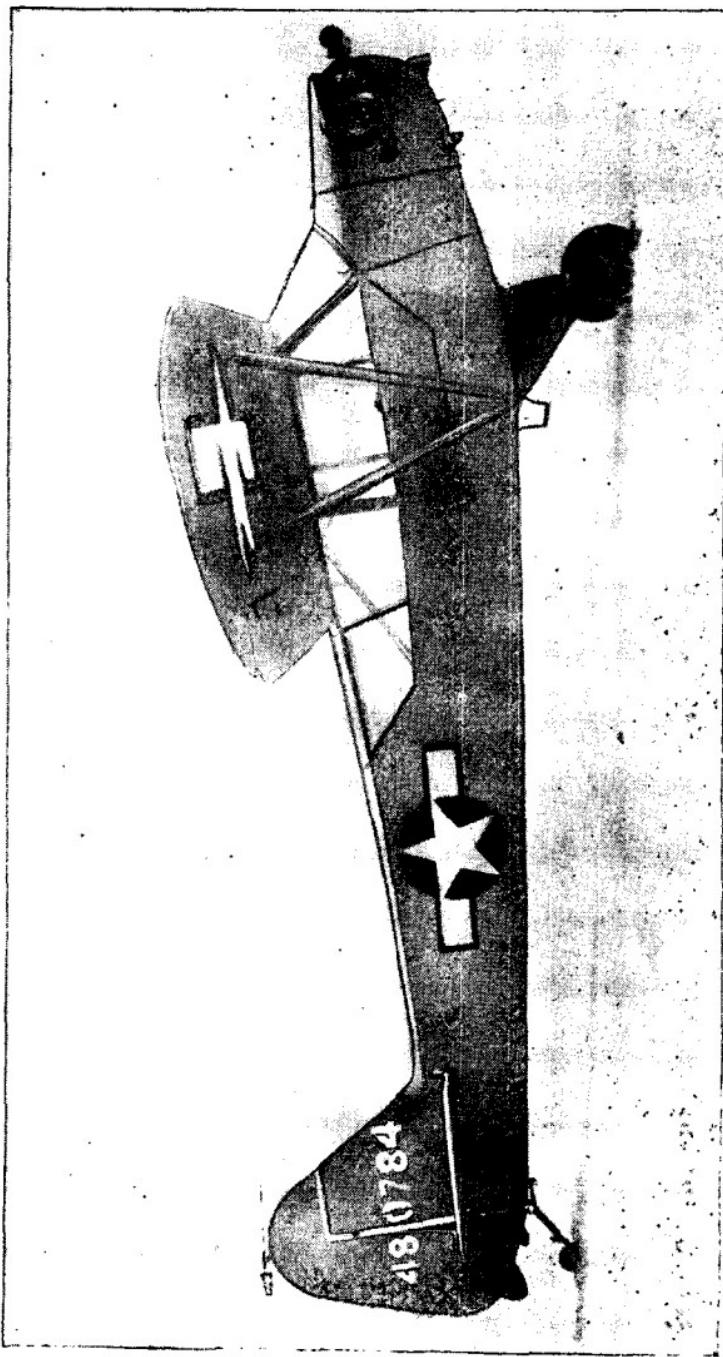


Figure 1. Army Ground Forces aircraft (L-4J).

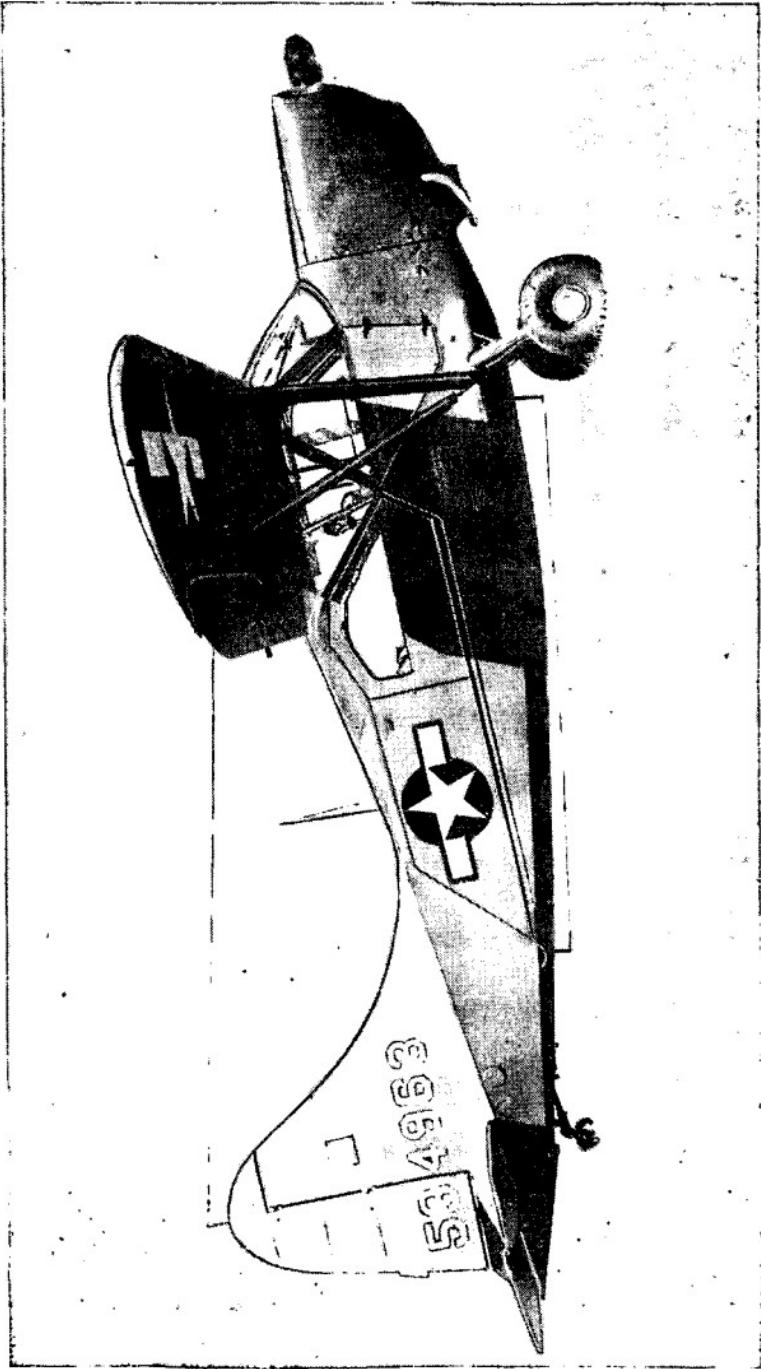


Figure 2. Army Ground Forces aircraft (L-5G).

ing of his air section personnel. Individuals assigned to the air section should be examined promptly to determine the type and amount of training each will require to complete both the tactical training program of the unit and the individual training program for members of the air section. The training program of the air section must be flexible and progressive.

**8. SCOPE OF TRAINING.** a. Officer and enlisted personnel of each air section, including pilots, should be thoroughly trained in their basic arm prior to receiving specialized training in the air section. Prospective pilots for the several arms are selected from officers having a general proficiency in that arm prior to being detailed for pilot training.

b. Programs for specialized training of air section personnel should distinguish between individual and tactical training. Training of air section personnel as members of the air section is termed *individual training*. Inclusion of the air section in the tactical exercises or field problems of the organic unit is termed *tactical training*.

**9. CONDUCT OF TRAINING.** a. Individual and tactical training should progress concurrently. Tactical training of the air section should be conducted under the direct control of the unit commander and should parallel the tactical training of the unit. It should be kept in mind during tactical training that the air section may function in combat as an integral part of its organic unit or it may operate under centralized control of higher headquarters. Tactical

training should be conducted in both types of operation.

- b. Because of limited landing areas, and for convenience of instruction and operation, it may be necessary or desirable to centralize in higher headquarters the control of individual training of air personnel. Such centralization should not preclude the return of air section personnel to their respective units for concurrent tactical training.
- c. Tactical training of air sections should be conducted concurrently with other training.

**10. INSPECTIONS.** Commanders of the larger units must keep themselves informed as to the state of maintenance and progress of training of all air sections in their subordinate units. To this end, frequent inspections should be made by their air officers. A guide for such inspections is contained in appendix II.

## CHAPTER 2

### INDIVIDUAL TRAINING

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- 11. GENERAL.** Individual training includes—
- a. Ground handling of aircraft.
  - b. Communication training.
  - c. Flight training.
  - d. Observer training.
  - e. Maintenance of aircraft, vehicles, and weapons.

- 12. LANDING FIELDS FOR INDIVIDUAL TRAINING.** A landing field selected for individual training should be—

- a. Located outside the traffic pattern of any airfield from which high performance aircraft operate. (See fig. 3.)
- b. Large enough to permit safe operations under all conditions.

- 13. GROUND HANDLING.** To prevent injury to personnel and damage to the aircraft, all members of the air section must be instructed in the proper methods of handling aircraft on the ground.

- a. Pushing and turning aircraft.** (1) The only parts of the aircraft to which pressure may be applied in pushing and turning are the end of the struts, the propeller hub, and the tail lift handles.

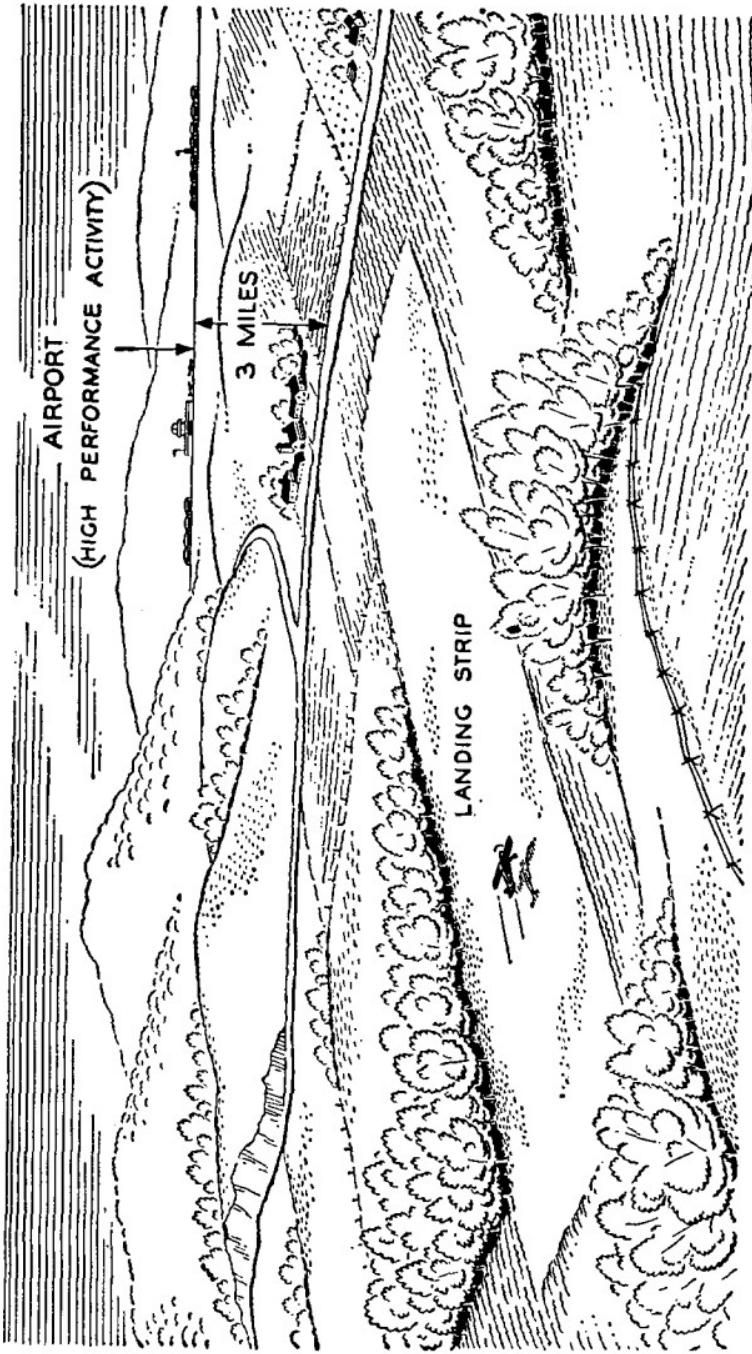


Figure 3. Example of suitable landing field for training.

(2) Caution should be exercised when pushing at the propeller hub, because an engine hot from recent operation may "kick" when the propeller is moved only a very slight amount.

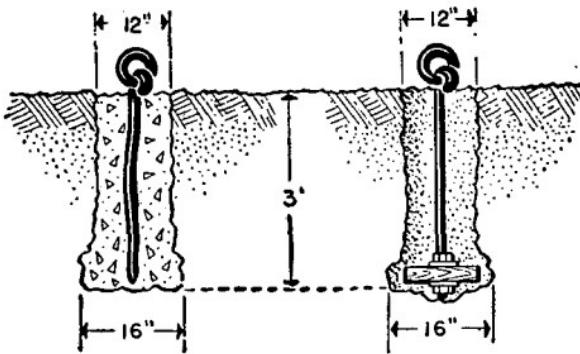
(3) A member of the ground crew capable of correctly estimating clearances should be at each wing tip when maneuvering in the vicinity of obstructions.

(4) The tail lift handles should always be used in lifting the tail or turning the aircraft by moving the tail.

**b. Tie-downs and control locks.** Aircraft should never be left unattended until tied down with controls locked in order to secure the aircraft against damage by winds. (See figs. 4 and 5.) Mooring ropes should be tied to the aircraft only at the wing strut fittings, the tail lift handles, and the tail wheel. Long tent stakes or barbed wire entanglement stakes may be used as temporary tie-downs when high winds are not expected.

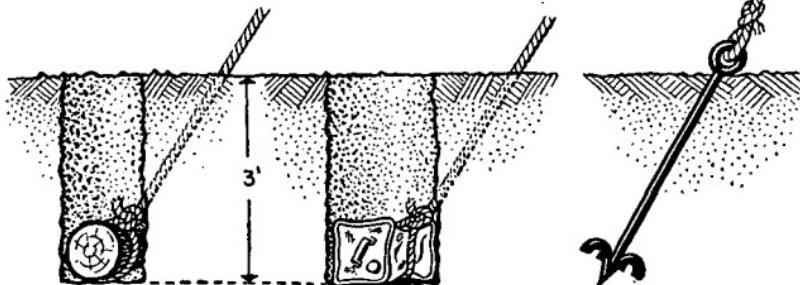
**c. High wind precautions.** Units should make arrangements with higher headquarters to obtain advance forecast of high winds. To secure aircraft against high winds, the following precautions may be taken:

(1) Lessen the angle of attack and reduce the lift effect of the wind by heading the aircraft into the wind with the wheels dug in and the tail raised approximately to the level-flight position. Unless proper drainage can be established, wheel pits should be no deeper than the brake drum to prevent accumulated water from entering the brake mechanism of the wheels.



IRON ROD WITH RING.  
SET IN CONCRETE. USED  
FOR PERMANENT MOORING.

LONG EYE BOLT THROUGH  
2"X 4" BOARD OR LARGER.  
SEMIPERMANENT.  
MAY BE MADE UP AND  
CARRIED IN TRUCK.



DEADMAN:  
LOG 6" DIA. OR LARGER.  
ROPE CABLE, OR CHAIN  
ATTACHED. (ROPE MAY  
ROT IN MOIST SOIL)

DEADMAN:  
5" GALLON CAN CRUSHED  
SLIGHTLY IN CENTER TO  
PREVENT ROPE SLIDING OFF;  
GOOD IN LOOSE SOIL OR SAND.  
FILL CAN WITH DIRT OR SAND.

PORTABLE MOORING KIT  
FURNISHED WITH AIRPLANE.  
FAIRLY DEPENDABLE EXCEPT  
IN LOOSE SOIL OR SAND.  
SLANT SAME AS ROPE.

*Figure 4. Types of tie-downs.*

(2) Block out the force of the wind by placing a truck or sandbags on the windward side of the aircraft.

(3) The lifting force caused by wind moving past the wings may be minimized by tying a "spoiler" (a board approximately 2 inches by 4 inches by 12 feet, padded with burlap, canvas, or

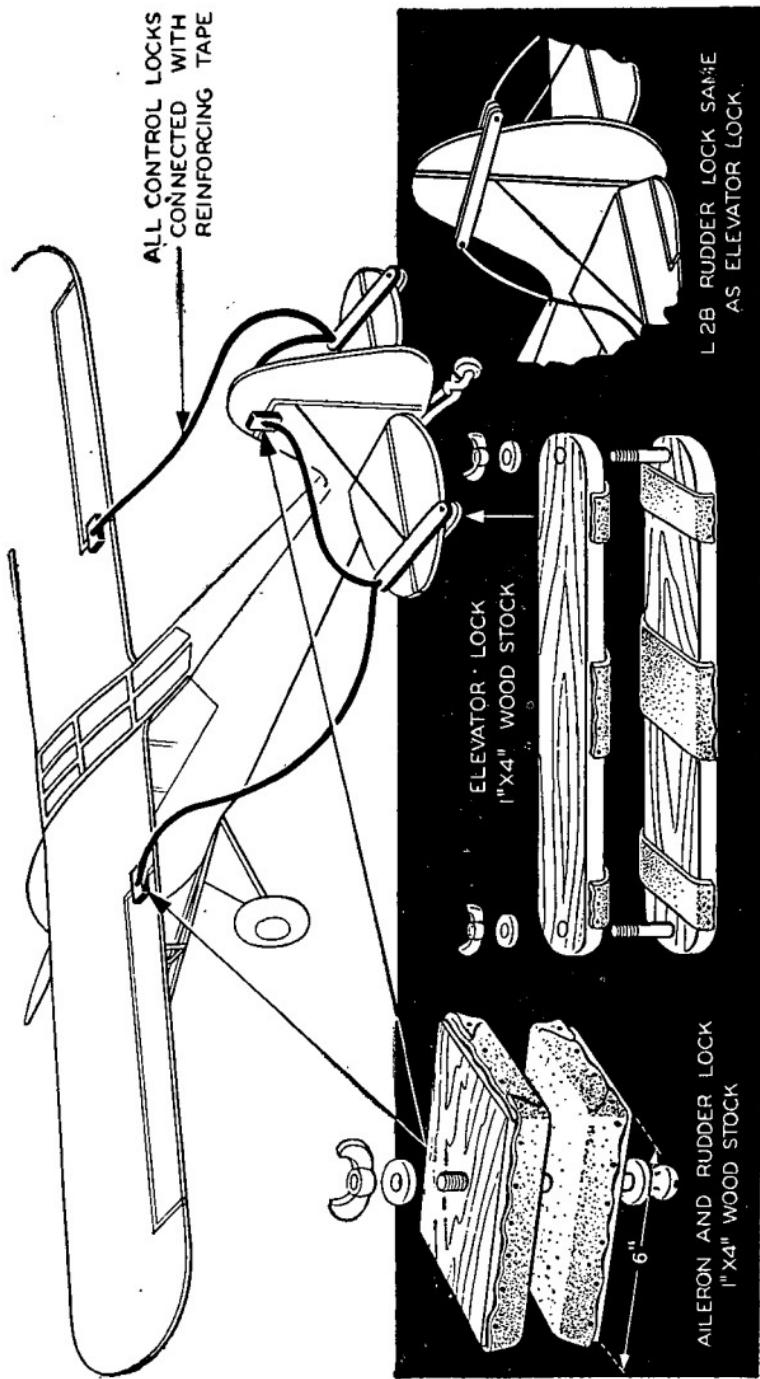
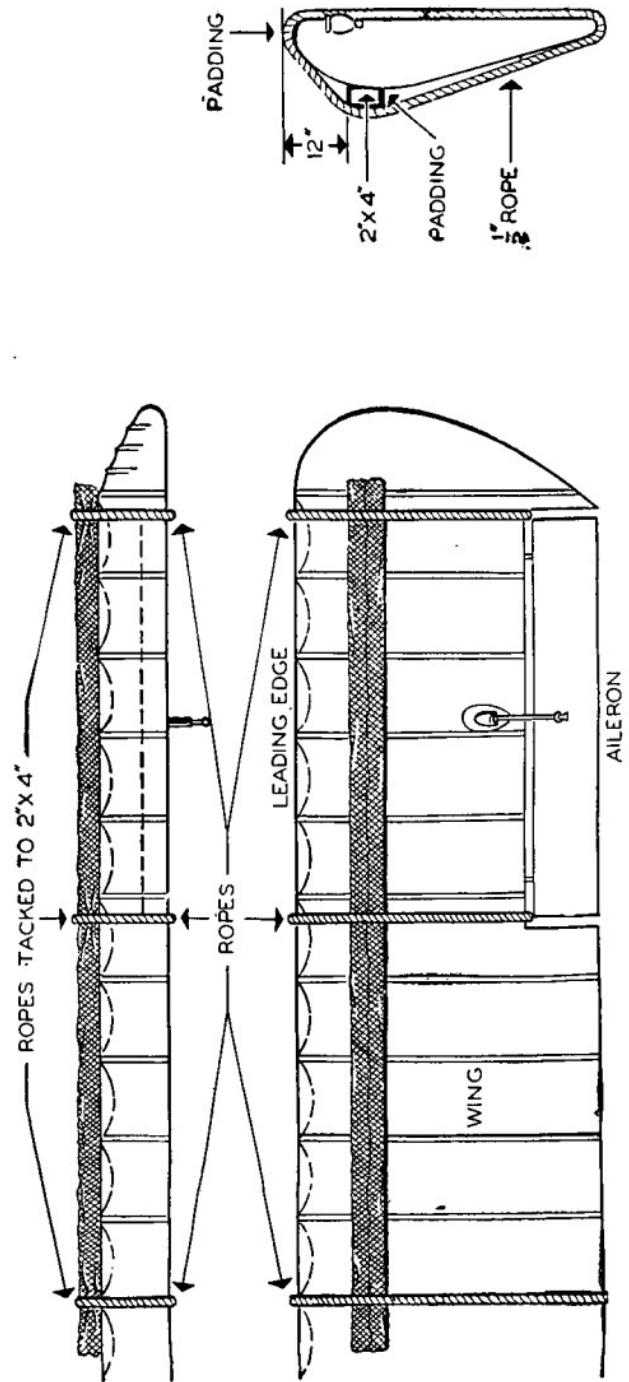


Figure 5. Control locks.



NOTE:  
MAXIMUM SPOILER EFFECT IS OBTAINED IF  
 $2' \times 4'$  IS PLACED 12" TO REAR OF LEADING EDGE

*Figure 6. Use of the spoiler.*

similar material) to the upper surface of each wing along the front spar. (See fig. 6.)

d. **Camouflage.** Maximum use of natural concealment should be practiced. However, it is often necessary to enhance natural concealment or to conceal the aircraft entirely by artificial means. The employment of nets and other camouflage materials should be carried out in the ground handling phase of training. Covers for insignia, shiny surfaces, and other distinctive features may be made of burlap or similar material.

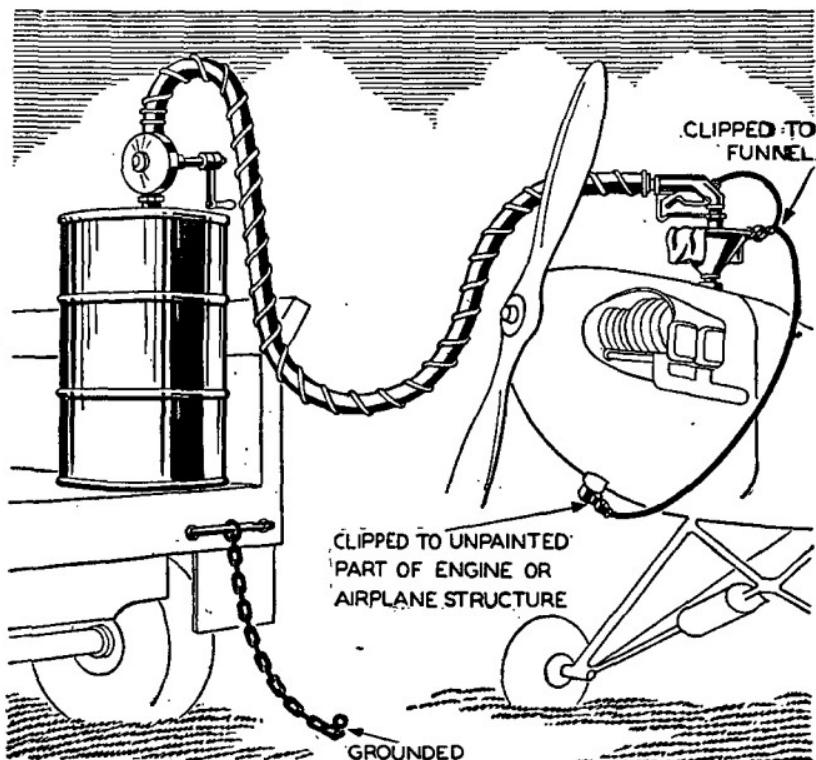


Figure 7. Grounding during refueling.

**e. Refueling.** (1) The aircraft should be electrically grounded in accordance with appropriate Army Air Forces Technical Orders before and during refueling. (See fig. 7.)

(2) Fuel should always be strained through a chamois.

(3) Fuel tanks and fuel cans should never be left partially full overnight but should be refilled to prevent condensation within the tanks or cans. If water is known to be in gasoline cans, the last half gallon in each can should not be used in aircraft but may be used in vehicles.

**f. Starting aircraft engines.** All members of the air section should be trained to start the aircraft engines using correct procedure. Wheel chocks should be applied before the starting operation.

**g. Taxiing.** All members of the air section should be trained to taxi each type of aircraft.

**14. COMMUNICATION.** All personnel of the air section must be thoroughly trained in the following means of communication:

**a. Radio.** Radio is the normal means air-ground communication. Radio training should include:

(1) Radiotelephone procedure.

(2) Installation and operation of the radios used in the aircraft.

(3) Operation of all types of radios that may be used as base sets at the landing field.

(4) Frequent practice with the unit command post to develop teamwork.

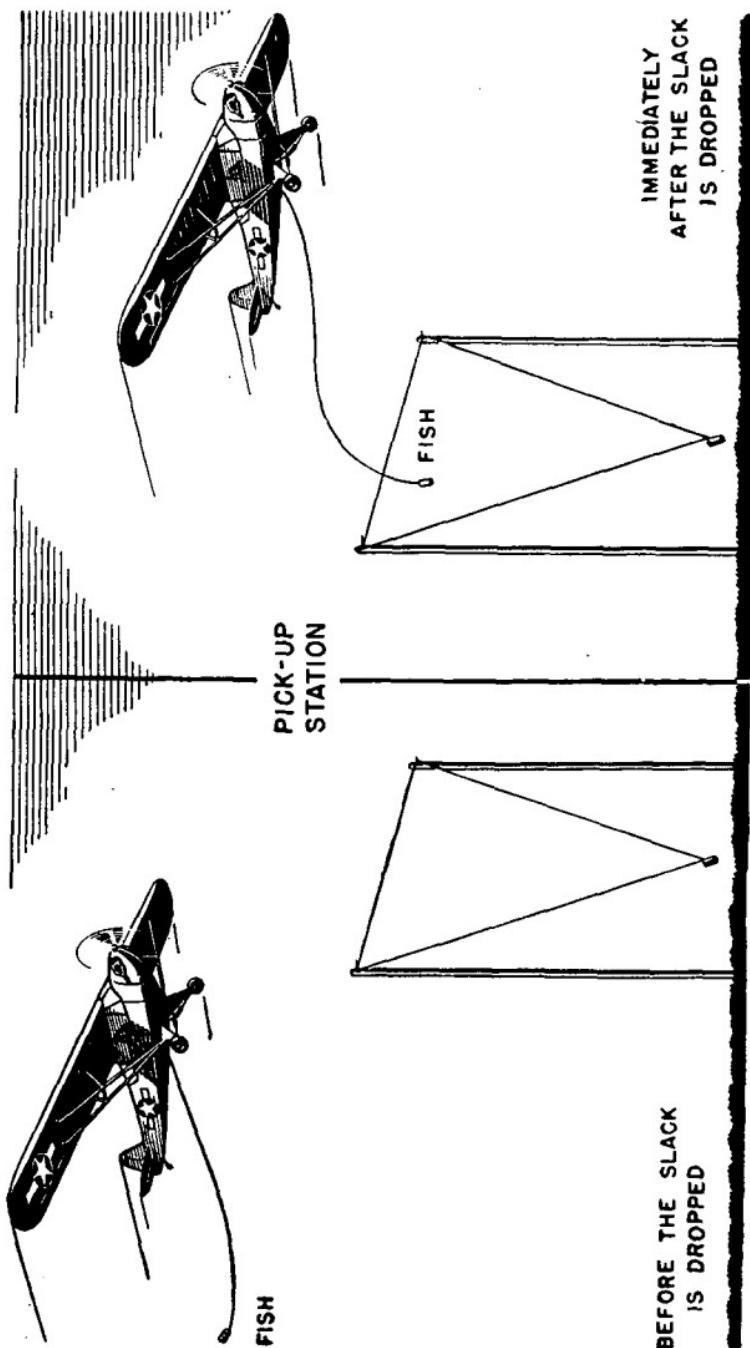


Figure 8. Pick-up station, message bag suspended from poles.

**b. Wire.** It should be standard practice for the unit communication officer to establish wire communication from the command post to the landing field as soon as possible. All air section personnel must be able to install, maintain, and operate wire communication at the landing field.

**c. Drop message and pick-up station.** When other means of communications cannot be used, a drop message and pick-up message system may be used to deliver and receive messages. (See fig. 8.)

(1) Air section and message center personnel should be familiar with the operation of this system as outlined in FM 24-17. A special pick-up weight with reel and line is issued by the Army Air Forces for use by liaison aircraft. A further prearrangement of panels at the pick-up station is advised to indicate when the message is ready to be picked up.

(2) A method requiring less equipment is shown in figure 9.

(a) The ground station is operated by two men. The message is attached to a long cord which has a small sandbag at each end. The two men throw the line up so that it is caught by the aircraft pick-up line.

(b) The men on the ground can adjust their positions to the flight path of the aircraft, greatly simplifying the procedure for the pilot.

**15. FLIGHT TRAINING.** Pilots must be prepared to fly in combat under varying conditions of weather, terrain, and movement. To insure main-

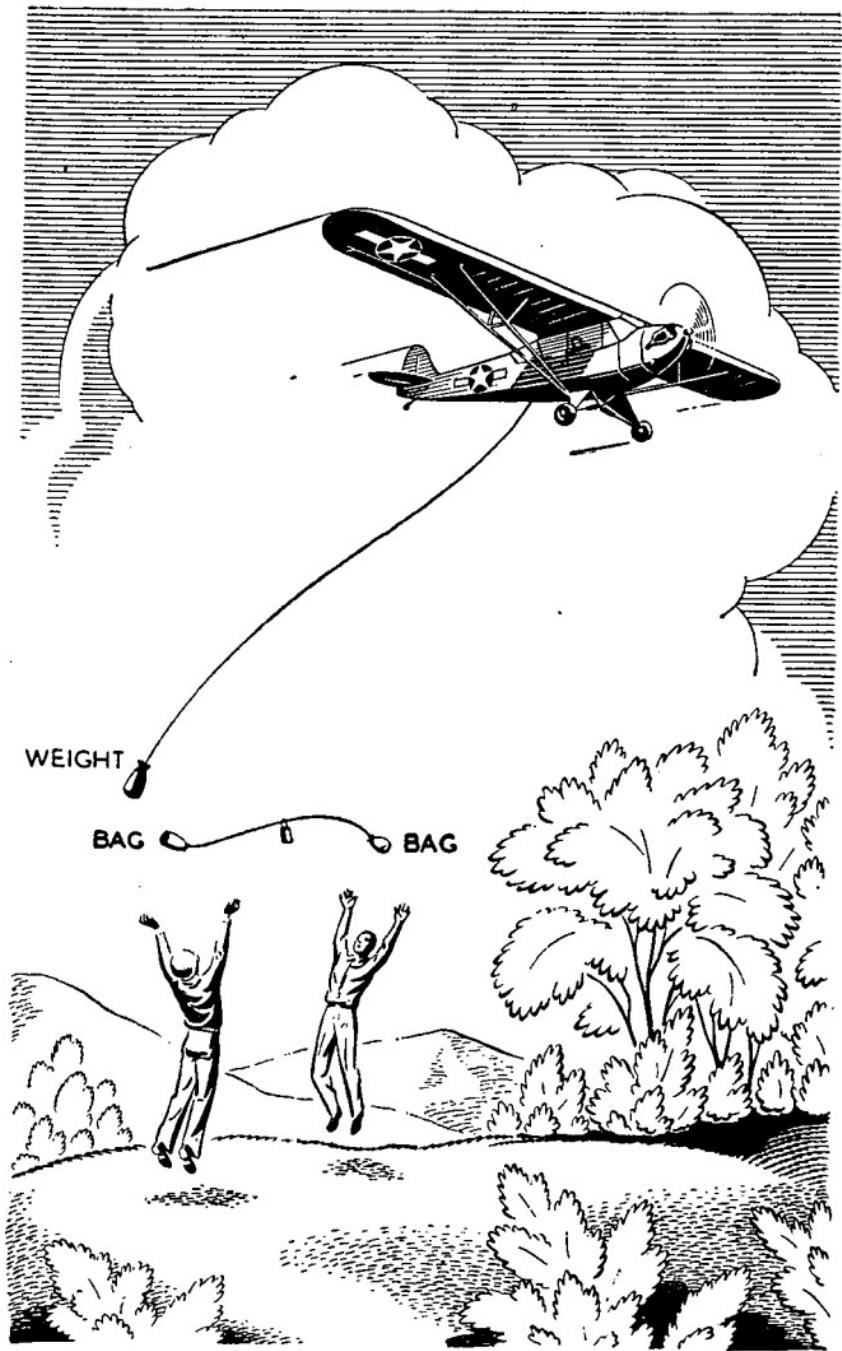


Figure 9. Pick-up station, message bag tossed up by two men.

tenance of the necessary high standard of flying proficiency, air sections plan for frequent reviews of basic subjects, flying maneuvers, and all types of flights.

a. **Ground school.** Pilots must be thoroughly familiar with the following subjects and references:

(1) *Navigation.* Before making extended flights, pilots should know the material pertinent to Army Ground Forces light aviation covered in TM 1-205.

(2) *Meteorology.* Since pilots in combat will often be their own weather forecasters, they must have a working knowledge of meteorology. War Department Technical Manuals 1-231 and 1-232 contain sufficient information for Army Ground Forces pilots.

(3) *Pilot's Information File.* The pilot should know all information applicable to Army Ground Forces light aviation contained in his Pilot's Information File, published by the Army Air Forces.

b. **Basic flight maneuvers.** Pilots must retain their proficiency in—

- (1) Take-offs and landings.
- (2) Coordination exercises
- (3) Level turns.
- (4) S-turns.
- (5) Rectangular courses.
- (6) Eights around pylons.
- (7) Climbing and diving turns.
- (8) Slips
- (9) Two-turn power-off spins.
- (10) Lazy eights.
- (11) Chandelles.
- (12) Stalls.

c. **Special flight maneuvers.** Pilots must also be proficient in—

- (1) Take-offs and landings between panels.
- (2) Take-offs and landings over barriers.
- (3) Take-offs and landings on roads.
- (4) Cross-wind landings and take-offs.
- (5) One wheel landings and take-offs.
- (6) Contour flying (when specifically authorized and in specified areas only).
- (7) Landings from contour approaches.
- (8) Evasive maneuvers.

d. **Extended flights.** The unit commander designates the local flying area, and reports its location in accordance with AR 95-15. Any flights outside this area are extended flights. Tactical operations require long and short extended flights.

(1) Extended flights normally begin with short trips to air bases which do not have much traffic. As pilots become more proficient, they should make long flights at normal altitudes above 500 feet, finally they must make low-level displacement flights which are often necessary in combat. Pilots should make from two to four extended flights each month.

(2) Extended flights are governed by the following conditions:

(a) Each flight must be specifically authorized by the unit commander.

(b) An extended flight will be authorized by the unit commander only when the pilots—

1. Are thoroughly familiar with Army Air Forces Regulation 60-16.

2. Are familiar with Army Air Forces Forms 15, 17, and 23. (See app. VII.)
3. Have demonstrated a knowledge of ground school subjects, covered in a above.
4. Have submitted complete flight plans to the nearest army air base operations office and obtained proper clearance.
5. Have a thorough knowledge of control tower flight signals.

(c) Where practicable, pilots land only on fields operated by the Army of the United States. Landings at private airports are to be made only when authorized by proper authority or in event of emergency.

(d) Pilots should be ordered to notify their unit commander by telegraph or telephone when they remain away from their home field overnight.

e. **Night flights.** Army Ground Forces light aviation can be highly useful in night operations.

(1) Night flights involve the following additional hazards:

(a) Take-offs and landings are more difficult to accomplish because the ground and obstructions are less visible.

(b) There is more danger of the pilot becoming lost.

(c) Collision with other aircraft is more likely.

(d) It is sometimes necessary for the pilot to resort to short periods of instrument flying due to unforeseen conditions of poor visibility.

(e) There is danger of being fired upon by friendly antiaircraft artillery and other ground troops, as well as being attacked by friendly night fighters.

(2) Training in night flying should begin only when the following conditions can be met:

(a) The pilot must be reasonably proficient in basic instrument flying.

(b) The aircraft must be equipped with proper position lights, luminous instruments, and a bank and turn indicator.

(c) The training field should be approximately twice the size of that required for day flights. It must have clear approaches. Boundaries and high obstructions in the vicinity of the field must be lighted. (See fig. 10.)

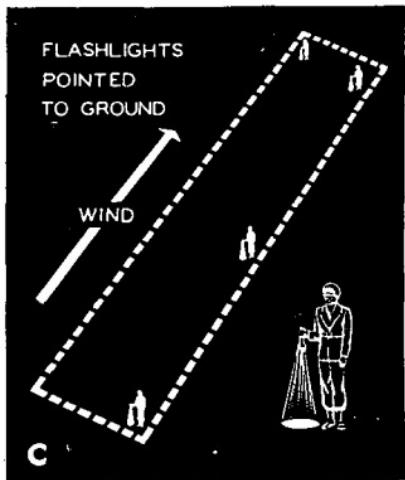
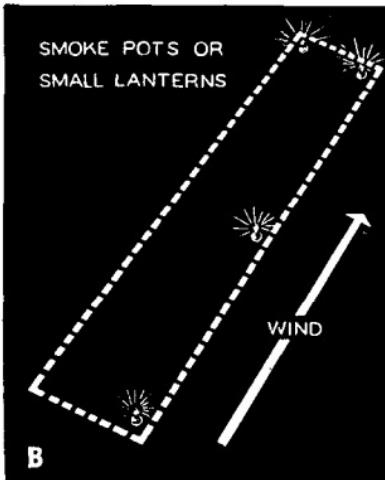
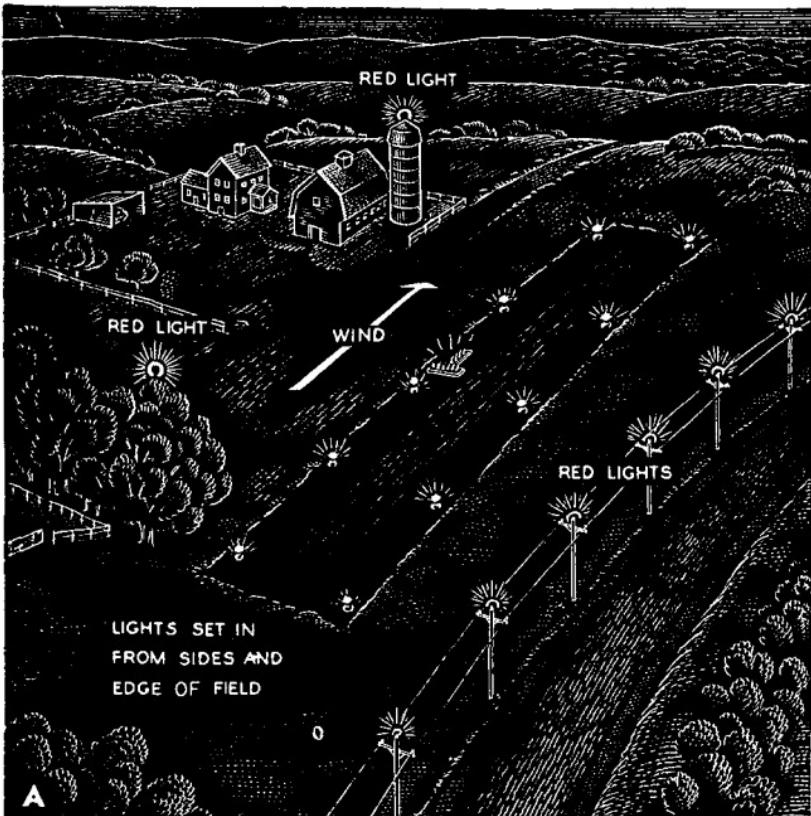
(3) The plan of night flying training includes:

(a) Elementary flight maneuvers such as take-offs, landings, and gentle turns at dusk and on moonlight nights when visibility is good and the ceiling is unlimited. This training progresses to darker nights as proficiency of the pilot increases.

(b) Night navigational training flights to specific points or areas 20 to 30 miles away from the training field.

**16. OBSERVER TRAINING.** The success of the Army Ground Forces light aviation may often depend upon the proficiency of the air observers. Observers should receive intensive training in intelligence reporting. This training is supervised by the unit S-2. Observers are taught to adjust artillery fire from the air.

**a. Personnel to be trained as air observers.** The pilot must be a trained air observer because he may have to fly alone on certain occasions. However, it has been found in combat that the pilot cannot



*Figure 10. Lighting of training field and boundaries for night flying.*

fly and observe efficiently at the same time; therefore, selected personnel are trained as aerial observers. Those selected for training must weigh less than 170 pounds. Two or more officers of each unit are normally detailed as air observers. The air observer must be a capable officer because the combat effectiveness of the entire unit often depends on his skill as an observer.

**b. Training phases.** The training of the air observer is divided into two phases, ground training and air training, which are generally conducted concurrently. Emphasis in both phases should be placed on map reading and conduct of fire.

(1) Ground training includes:

(a) Nomenclature, characteristics, functioning, and ground handling of the aircraft.

(b) Cockpit procedure and safety precautions.

(c) Thorough training in the use of maps and air photos.

(d) Conduct of fire using range-bracketing procedure modified for air observation.

(e) Study of friendly and enemy weapons, vehicles, and tactics to enable instant recognition and to facilitate analysis of what is seen from the air.

(f) Radio operation and procedure.

(2) Air training includes:

(a) Orientation flights to accustom the observer to the maneuvers of the aircraft in flight and to enable the observer to maintain his sense of direction while flying. He must practice estimating ground distances from various altitudes.

(b) Comparison of terrain features with maps and aerial photographs of the area.

(c) Simulated fire missions and reconnaissance missions.

(d) Fire missions during service practice. Even when he is not firing, the observer can gain experience by observing the conduct of fire by both ground and air observers and reporting the effectiveness of the fire. When radio is used, the air observer can hear all traffic in the net. When telephone is used, the corrections of the ground observer should be relayed to the air observer by radio. Targets are habitually designated by reference to map or photo coordinates.

(e) Local and extended flights further to accustom the observer to maintaining his sense of direction in flight.

(f) Training of pilot and observer as a team. Engine noise makes conversation between the pilot and observer difficult. Both the pilot and observer must be able to anticipate each other's needs and problems in the air.

(g) Frequent flights, during field exercises, from the *enemy* side of the area, observing movements, positions, matériel, and gun flashes of the parent unit. An intelligence report is made after the flight to include the principles outlined in paragraph 27. Field glasses will be found useful for identification of vehicles and installations. •

**17. MAINTENANCE TRAINING.** a. Pilot. Since the senior pilot in each air section is charged with the supervision of maintenance and repair of air-

craft and vehicles, his training must insure that he is qualified to—

(1) Direct the first and second echelon maintenance of aircraft and vehicles of his air section.

(2) Supervise the performance of the required inspections to determine serviceability of airplane and engine.

(3) Analyze mechanical failures.

(4) Accomplish emergency aircraft repairs in the event of a forced landing.

**b. Senior and junior mechanics, airplane and engine.** Mechanics should be thoroughly trained and qualified to effect—

(1) Aircraft inspections.

(2) Parachute inspections.

(3) Compass compensations.

(4) First and second echelon aircraft repairs.

(5) Erection of crated aircraft.

(6) Preparation of aircraft for oversea shipment according to Army Air Forces Technical Orders.

(7) Loading of aircraft on vehicles.

(8) Operation and first echelon maintenance of air section motor vehicle equipment.

(9) Operation and first echelon maintenance of air section weapons.

## CHAPTER 3

### TACTICAL TRAINING AND EMPLOYMENT

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**18. GENERAL.** a. An important characteristic of liaison aircraft is their capacity for operation away from a fixed installation over long periods of time with limited supplies and equipment. It is this characteristic which permits their employment as organic aviation by Army Ground Forces units.

b. To minimize the risk of detection and attack by hostile ground and air forces, the aircraft normally flies at the lowest altitude consistent with the success of the mission. Additional altitude may at times be necessary to avoid hostile ground fire.

c. Tactical training includes:

- (1) Reconnaissance, selection, improvement, and operation of landing fields.
- (2) Security measures.
- (3) Displacements.
- (4) Obtaining information on simulated hostile and friendly forces.
- (5) Locating appropriate targets.
- (6) Adjusting fire.
- (7) Patrols for maintaining continuous aerial surveillance of simulated enemy forward areas.
- (8) Aerial route reconnaissance..
- (9) Control of march columns.

- (10) Radio relay.
- (11) Aerial photography.
- (12) Aerial supply.
- (13) Camouflage inspection flights.
- (14) Aerial evacuation.
- (15) Air messenger or courier.

**19. STAFF RELATIONS.** Each staff section must be familiar with the needs, the capabilities, and the manner of employment of the organic aircraft.

a. **S-2.** (1) S-2 keeps the pilots and observers continually informed of the enemy situation. The pilots and observers on the other hand are a valuable source of information for S-2 concerning activity in the unit sector.

(2) S-2 will furnish the air section with information as to areas defiladed from ground observation, so that the aerial observers can better supplement ground observation.

b. **S-3.** To reduce to a minimum the time required to perform a mission, S-3 briefs both pilot and observer with all information necessary for the accomplishment of the mission. The maximum pre-arrangement between S-3 and the air section will also help reduce the duration of the mission.

c. **S-2 and S-3.** (1) At the completion of the mission, S-2 and S-3 or their representatives question the pilot and observer in order to determine the results obtained and other pertinent information.

(2) In order to understand fully and best utilize the air section, S-2 and S-3 should function as

air observers on occasion. There should be a pre-arrangement between S-2 and S-3 on proposed missions in order to determine exact information desired from the mission.

**d. Headquarters company (battery) commander.** In order to provide proper personnel and supplies to the air section when needed, the headquarters company (battery) commander must be familiar with the duties of air section personnel. He should facilitate the functioning of the air section as a team.

**20. RECONNAISSANCE, SELECTION, IMPROVEMENT, AND OPERATION OF LANDING FIELDS.** **a. Reconnaissance.** The selection of landing fields requires a thorough understanding of the capabilities of Army Ground Forces aircraft; consequently, reconnaissance for forward landing fields will usually be carried out by a pilot with the aid of his ground crew. To insure availability of the air section immediately following a displacement, it is important that the unit commander inform his air officer of an impending movement at the earliest possible moment, and that close liaison be maintained between the unit S-3 and the senior pilot. After making a map or photo reconnaissance, further reconnaissance for landing fields can be accomplished by one of the following general methods:

(1) *Air.* As soon as the area into which the unit will move and the probable location of the command post is known, the senior pilot accompanied by a member of the ground crew should make an

aerial reconnaissance to select the most satisfactory location for a landing field and to check the road net leading to the field selected. The ground crewman can then lead the ground crew and equipment to the new field and reconnoiter and prepare the new field before the aircraft are flown forward. This method is advantageous in mountainous terrain when time is limited. In an emergency the aircraft may fly to the new field before the new field has been reconnoitered by the ground crew on the ground.

(2) *Ground.* In open terrain a ground reconnaissance may prove entirely satisfactory. The pilot with a member of the ground crew may go forward by vehicle to select the new field. When feasible the pilot should accompany the unit reconnaissance party.

(3) *Air and ground.* When time is not limited, a combination of air and ground reconnaissance will prove most satisfactory. Various adaptations can be made to suit the situation.

b. **Selection.** All observers, certain personnel in headquarters and service companies (batteries) and air section personnel must be competent in selecting suitable landing fields.

(1) A landing strip must be—

(a) Sufficiently long for take-offs considering temperature, altitude, slope of the ground, and prevailing wind.

(b) Smooth enough for aircraft to take off from and land on without damaging the aircraft.

(c) Clear of obstructions. If obstructions hinder take-off or landing, the strip must be long enough

to permit take-offs and landings under all weather conditions. If the strip is completely walled in by trees and other obstructions, the dead or turbulent air within the walled-in area will greatly increase the hazards of taking off and landing.

(d) Selected with consideration to the direction of the prevailing wind. Strong cross winds present a hazard.

(e) Clear of mines. In some cases satisfactory mine detection can be carried out by air section personnel. However, trained engineer personnel should check the strip and adjacent areas for mines and remove mines when necessary.

(f) Adequately drained. Liaison aircraft cannot operate continuously from flooded or extremely muddy areas. If a dry strip cannot be located, engineer personnel are requested to emplace a landing mat.

(2) In combat a landing field or strip should be—

(a) Defiladed from enemy terrestrial observation.

(b) Located conveniently near the unit command post to insure adequate communication.

(c) Adequate for dispersion and natural camouflage of aircraft, equipment, vehicles, and installations.

(d) Available to routes of supply and communications.

(e) Out of enemy light artillery range.

(f) Located within the perimeter defense of the unit if enemy infiltration attacks are likely.

c. **Improvement.** Improvement of the landing field begins immediately after the field has been

selected. It is necessary that detection by the enemy be made difficult.

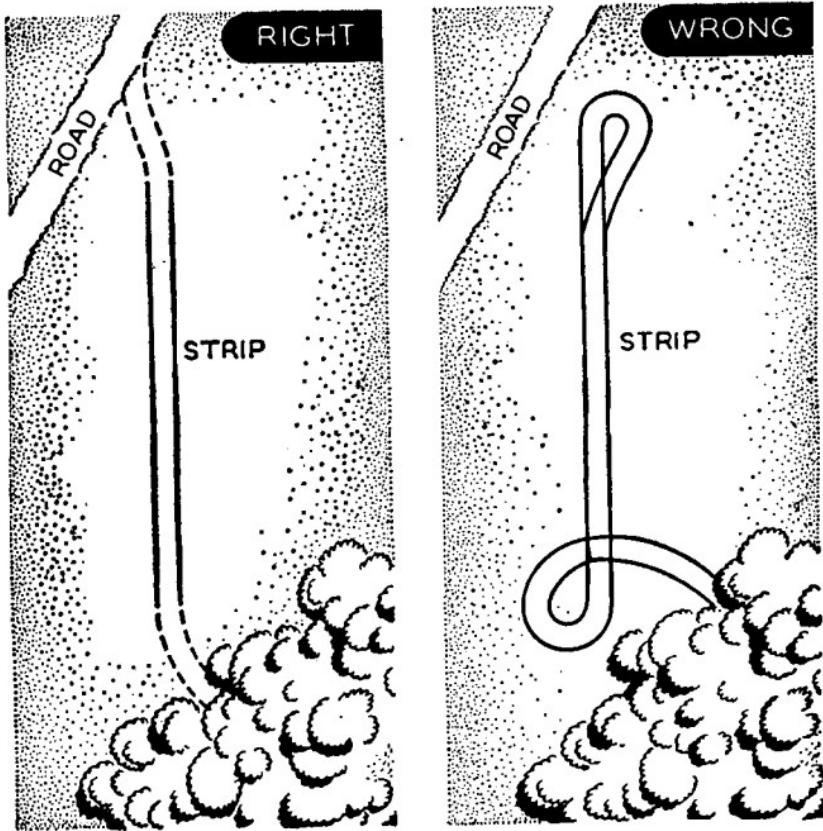
(1) *Development of landing field.* Before aircraft are displaced to a new field, the landing strip is—

(a) Cleared of mines and booby traps.

(b) Pioneered. Within limits dictated by considerations of flying safety, pioneer work should be restricted to a minimum to avoid making the strip obvious from the air. Rocks, trees, heavy underbrush, and other obstacles should be removed and all holes and ruts filled. If the strip is dangerously wet or muddy, it may have to be graveled or pierced steel planking may have to be laid by engineer personnel at the expense of concealment.

(c) Concealed. As illustrated in figure 11, vehicular tracks may be used to extend the outline of the landing strip beyond its usable limits into a road or group of trees. The landing strip, thus extended, appears from the air to be a road or trail.

(2) *Camouflage of installations.* Before the equipment of the air section is brought to the new landing field, a complete plan of camouflage should be drawn up. This plan should take advantage of all natural camouflage. Consistent with proper use of natural concealment, maximum utilization of the dispersal area should be made. As natural concealment decreases, the distances between aircraft should be increased. Distinctive insignia and shiny surfaces should be covered. Vehicles should be dispersed and camouflaged near the road leading to the landing field. The principles of camouflage and



*Figure 11. Concealment of landing strips.*

camouflage discipline set down in FM 5-20 must be adhered to as closely as possible. (See fig. 12.)

(3) *Security from ground attack.* When the terrain and enemy tactics make infiltration attacks on the landing field likely, the unit commander is responsible that adequate personnel are furnished for protection of the landing field. Whenever feasible, the landing field is located within the perimeter defense of the unit or other organization in the area. Air section personnel must be trained to set up

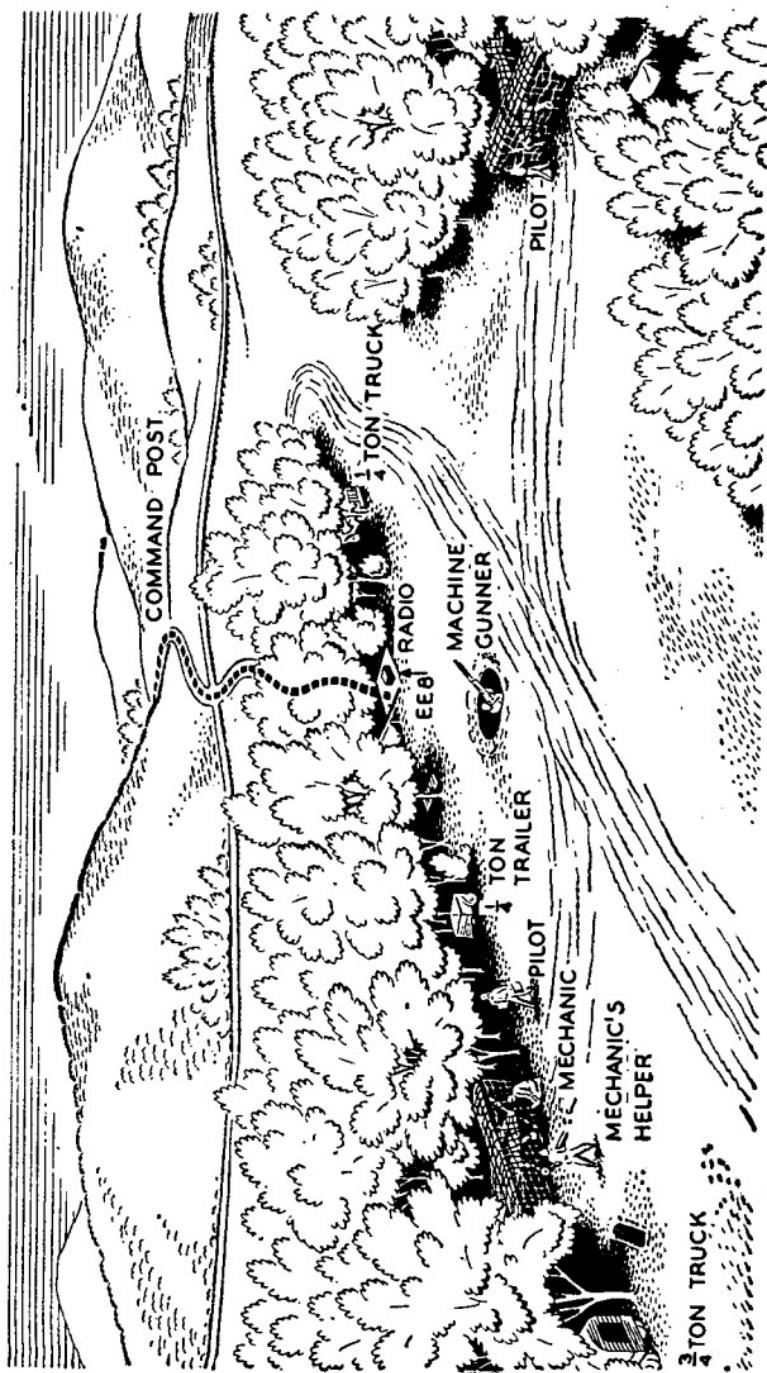


Figure 12. Organization of a landing field.

defensive position, particularly against night infiltration attack. Trip wires with noise-making devices and booby traps may be set up along likely enemy routes of approach and friendly personnel must be warned of their locations.

(4) *Other security measures.* (a) Organic automatic weapons are set up for protection against enemy aircraft.

(b) A section or platoon of light antiaircraft artillery frequently provides additional protection for the air section.

(c) Alternate fields, if available, are improved so that the air section may be readily displaced, preferably to the rear of the main field, in the event of persistent shelling or aerial attack by the enemy.

(d) Dummy fields, if cleverly prepared, deceive the enemy and divert much of his fire.

(5) *Communication.* Radio communication with the command post is established as soon as possible. As soon as time permits, wire communication between the command post and the landing field is installed.

d. **Operation.** The following general principles govern the operation of a tactical landing field.

(1) *Landing.* When the aircraft approaches, the ground crew marks the landing strip and assists the pilot in taxiing the aircraft to concealment immediately after landing. Two methods of marking the landing strip are as follows:

(a) The first few times a new strip is used, a "T" panel is placed by the ground crew at the downwind end to indicate direction of landing,

wind direction, and the end of the strip on which to land. A single panel is placed at the upwind end to mark the limit of the landing roll in the new strip. Panels are displayed only on prearranged signal and are removed as soon as the aircraft has landed. After a few landings have been made and the pilots are familiar with the location and limits of the strip, it is not necessary to display panels. (See fig. 13.)

(b) Two men guide the aircraft into a new strip as shown in figure 13.

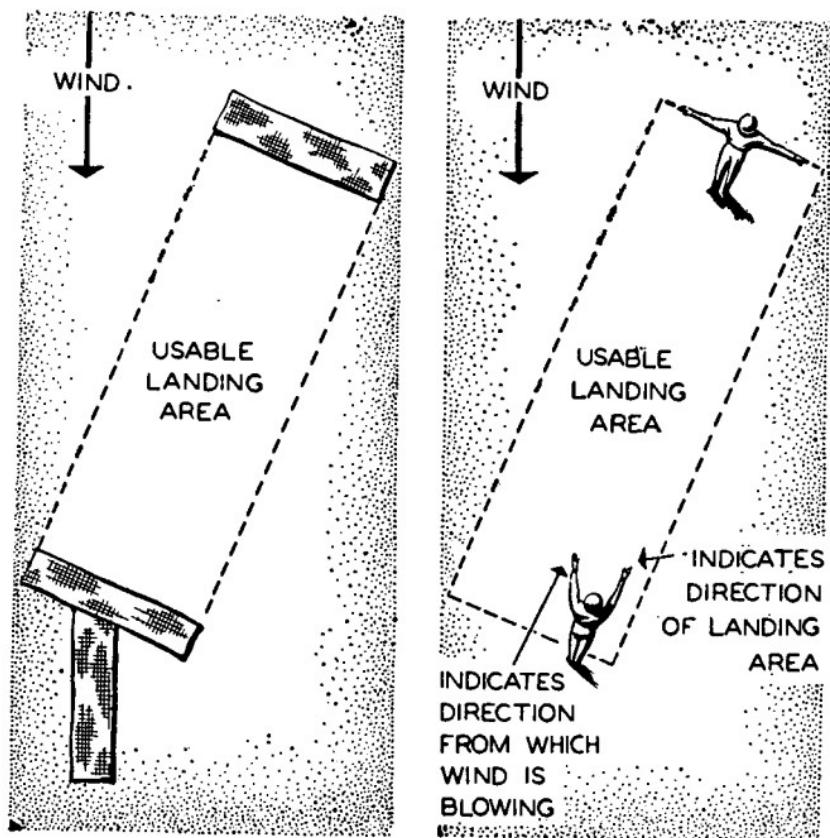


Figure 13. Marking landing strips.

(2) *Parking.* As soon as the aircraft has landed, the ground crew lifts the tail and turns the aircraft around, thus preventing a telltale loop at the end of the strip. (See fig. 11.) Then the pilot taxies the aircraft to concealment, guided by at least one man. When practicable, one man walks at each wing tip and another at the tail of the aircraft.

(3) *Take-off.* Prior to each take-off, the airplane engine is warmed up and radio communication is checked. Then, guided by the ground crew, the pilot taxies to the downwind end of the strip. The aircraft is turned by the ground crew by lifting the tail and swinging the aircraft into position.

**21. AIR SECURITY.** While in flight, the aircraft and its occupants are vulnerable to enemy attack both from the air and from the ground.

a. **Security from enemy aircraft.** Although Army Ground Forces aircraft may derive some measure of protection from friendly fighter aircraft and evasive maneuvers, an advance warning system provides the best protection. A pilot warned in time can usually avoid attack by enemy aircraft. Tactical operation of Army Ground Forces aircraft will be greatly influenced by the air situation (relative air superiority) and habits of the enemy with respect to attacking light aircraft.

b. **Warning systems.** (1) *Unit air warning net.* Before the aircraft takes off, all radio stations of the unit are instructed to watch for enemy aircraft and to break into the net with a warning if any are sighted. (See fig. 14.)

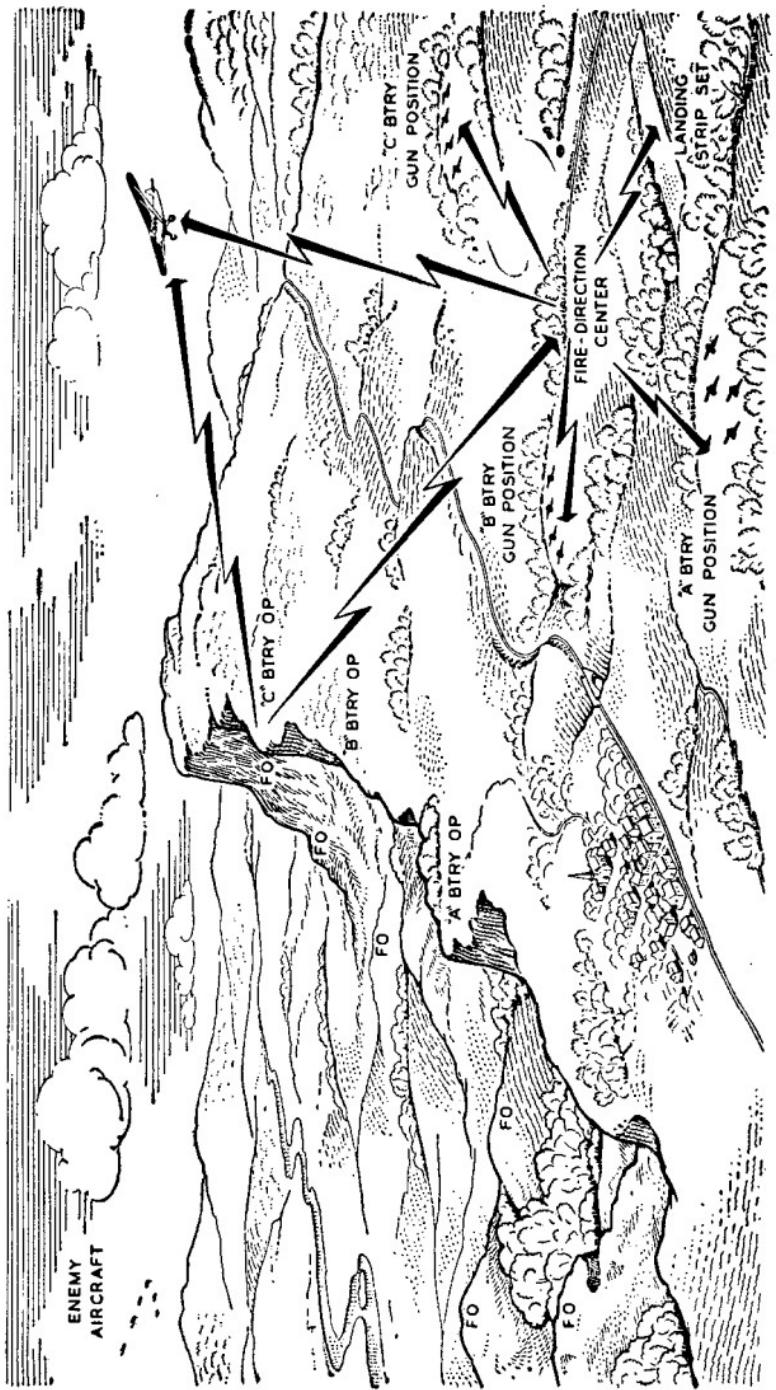


Figure 14. Aircraft warning system, field artillery battalion.

(2) Antiaircraft artillery intelligence service. Whenever possible, the unit monitors the antiaircraft artillery intelligence service net. Antiaircraft radar sets are capable of locating aircraft at considerable distances and can furnish the Army Ground Forces aircraft adequate warning through this net. Each air section should be equipped with a receiver which monitors the local antiaircraft warning net. This receiver is located at the landing strip or other location from which warnings may be relayed to aircraft in the air.

(3) *S-2 and S-3 warnings*. The unit S-2 and S-3 should provide the air section with available information concerning enemy air activity and planned friendly air operations in order to minimize light aviation flying hazards.

c. **Liaison with Air Forces units.** Information pertaining to unusual operations of Army Ground Forces aircraft such as night flights or emergency aerial supply missions is transmitted to army headquarters so that the appropriate tactical air command can inform the Air Forces units concerned.

d. **Flying missions.** The ability of fighter pilots to detect liaison aircraft in flight depends primarily upon two factors, the vertical distance between the two aircraft and the light conditions. Fighter pilots usually cannot see liaison aircraft flying 5,000 feet or more below them. The shadow of a low-flying aircraft can generally be detected much sooner than the aircraft itself.

e. **Evasive tactics.** Once aware of imminent attack by enemy aircraft, the pilot's safety depends on the maneuverability of his aircraft and his own

skill at evasive maneuvers. An abrupt diving turn toward the attacking aircraft has been found very effective in actual combat, especially if the turn is delayed until just before the attacking aircraft closes to firing range. After the first evasion, the enemy aircraft should be kept in sight in order to evade another attack. Because landing is normally a slow procedure, the pilot may prefer to dive for the ground and fly its contours. In contour flying, the pilot takes advantage of stream beds, valleys, tree lines, and low hills for concealment. The pilot may fly near friendly antiaircraft positions, thus bringing the enemy fighter within range of friendly antiaircraft fire.

**f. Security from enemy ground fire.** By varying the locality in which he flies and by changing his flight path widely during each mission, the pilot may prevent hostile forces from anticipating the time and position of his next appearance. Whenever practicable, the pilot should fly outside the effective range of known enemy antiaircraft fire.

**g. Security from outbound projectiles.** (1) Since Army Ground Forces aircraft must normally fly in advance or over friendly artillery, there is obviously danger of being hit by an outbound artillery projectile. In cases where a great amount of friendly artillery is massed in a narrow sector, the deployment of friendly guns should be ascertained and their probable trajectories should be avoided when possible. Flying directly in front of any artillery battery or tank company is dangerous and should be avoided.

(2) The use of VT (also referred to as *radio proximity*) fuzed projectiles greatly increases this danger, necessitating a prearranged plan to insure that the Army Ground Forces aircraft will not be flying in the vicinity of the trajectory of VT fuzed projectiles. While it is theoretically possible to establish an airspace between prescribed altitudes over the front lines, where the aircraft will fly and through which projectiles will not be fired, it is impracticable to achieve this condition. Aircraft should be grounded or should fly in rear of artillery position areas while VT fuzed ammunition is being fired. A highly organized warning system is necessary to accomplish this without undue loss of time. It will be the responsibility of any artillery unit commander who orders or authorizes the use of VT fuze not equipped with the variable time setting element that the simplest safety precautions appropriate to the immediate situation and the urgency of the fire are taken to avoid firing near friendly aircraft. The unit firing, time, duration of fire, and area of firing will be broadcast over the air warning net (see par. 55b) to all units whose aircraft may be flying over the area. The functions of the air warning net will be increased to include warnings of area in which VT fuze is being fired. SOI's will include a brevity code for use in transmitting such warnings. During periods of visibility and especially when the warning can not be given in sufficient time to clear the air, the artillery battalion or battalions firing the VT fuzed projectiles will maintain air and ground surveillance of the air and cease firing when friendly aircraft approach the danger zone of the trajectory.

**22. DISPLACEMENTS.** The procedure for displacing an air section will vary with terrain conditions, distances, and the time available. The commander notifies the senior pilot as early as possible of any intended unit displacement so that the pilot may have at least one aircraft ready for operation at the new landing field as soon as the unit is in its new position.

**a. General procedure for displacing air section.**

(1) The commander selecting a new position area should consider the availability of suitable fields for the operation of his aircraft. He informs the senior pilot of the unit as soon as the new position has been selected in order that the senior pilot may locate a landing strip and make plans to establish the new landing field.

(2) Whenever possible, the senior pilot makes the ground reconnaissance for the landing strip. The observer, mechanic, or other highly qualified personnel may substitute if necessary. During the reconnaissance, close attention must be paid to possible routes for taking the vehicles of the air section to the new strip. All members of the ground crew must be sufficiently trained in map and aerial photograph reading to accomplish displacements.

(3) After the landing strip is selected, the ground crew proceeds there immediately in order to make any improvements that may be necessary. The aircraft may then be notified to come forward by—

(a) Radioing instructions to the old landing field.

(b) Sending a member of the ground crew back with the instructions for the pilots.

(c) Following a predetermined schedule (provided accurate estimates can be made of the time

necessary for reconnaissance and improvement of the new landing strip).

(4) The aircraft leave the old landing field one at a time and approach the new field at a low altitude in order to avoid disclosing its location to the enemy.

(5) Continuous radio communication with the unit must be maintained so that the pilots may be kept informed of all developments.

(6) When a night displacement can be anticipated, the senior pilot makes his reconnaissance during daylight. Part of the ground crew displaces with the unit and improves the landing strip that night and the next morning. The aircraft then fly to the new strip early in the morning in accordance with prearranged plans. The aircraft must not attempt to fly to a strange strip during the hours of darkness.

(7) As soon as the landing field is ready for operation, the unit commander and his staff are notified.

**b. Example of typical displacement.** (1) The senior pilot has learned the hour of the intended displacement and the general area for his landing field. Accompanied by a mechanic, he flies to the assigned area, and from the air, selects tentatively two or three strips. Then they check the road nets for access to each of the tentative strips. The mechanic makes a sketch of the routes. The pilot and mechanic repeat the reconnaissance on the ground preferably in conjunction with the unit reconnaissance. At this time, they select the best of the tentative strips. In the event that time is short, the ground reconnaissance can be made by the

mechanic in conjunction with the actual displacement of the ground crew and equipment.

(2) On returning to the old landing field, the senior pilot informs the unit commander of the field location and makes arrangements for wire and vehicular communication between the unit command post and the landing field. The senior pilot decides on a prearranged time and interval for radio communication as well as a code phrase for calling the aircraft forward to the new strip. After the equipment is loaded, the ground crew proceeds by vehicle to the new landing strip and establishes the landing field. When ready, the senior mechanic radios the senior pilot that the strip is prepared for operation. Each aircraft is camouflaged and concealed as soon as it has landed at the new strip.

**23. CENTRALIZED OPERATION.** **a. General.** When the tactical situation permits, it will often be found advantageous to operate the aircraft of several units of a corps, division, division artillery, or group from a common landing field. Air traffic at the field, briefing and interrogation of pilots and observers, maintenance of a situation map, operation of messing facilities, aircraft maintenance, antiaircraft protection, local security, and routine supply matters are generally supervised and coordinated by the senior commander with the assistance of his air officer. Continuous surveillance of the unit sector by a constant air patrol is usually directed in which all pilots and aircraft participate.

**b. Organization.** (1) Camouflage and dispersal of aircraft and vehicles at the landing field must be planned and coordinated by the air officer of the

senior unit to accommodate the additional aircraft and equipment involved in centralized operation. Each unit air section maintains its identity and is assigned a definite dispersal area on the landing field.

(2) An operations center is set up in a central location at the landing field. It is equipped with radio and telephone communications, maintains an up-to-date situation map, and keeps intelligence reports. All aerial missions are coordinated through this center.

(3) A centralized mess should be set up for the personnel of the unit air sections on the field.

(4) The senior mechanic of the senior unit supervises the enlisted personnel by keeping a duty roster for kitchen police, and for work and ration details. It is desirable to arrange for an alert crew to service all the aircraft immediately after landing.

c. **Operations.** (1) Missions are coordinated in an effort to prevent duplication and to provide continuous aerial observation. At least one airplane of each unit air section should be available to its unit at any time.

(2) Wire communication must be maintained between the landing field and the senior unit command post. Every unit should be able to contact its air section at the landing field by telephone. A supplementary ground radio located at the landing strip is required for the operation of the air warning system, for contacting the aircraft in the air, and for contacting the command post should wire communications fail.

(3) Intelligence reports and a situation map must be kept up to date at the operations center. When the pilots and observers return from a mission, they are required to report all information obtained on the mission. Before taking off on a mission, they must be required to note recent intelligence reports and all changes in the situation.

(4) Displacements will generally be less frequent under centralized operation, and the time available for the selection and improvement of the landing field will be increased. Where practicable, displacements will be staggered so that the new landing field is in operation and communications established before the old field is abandoned.

(5) Forward landing strips located near each unit command post may be utilized if the terrain is favorable to their installation. The strips permit closer liaison between each unit and its air section and are especially advantageous in rapidly moving situations.

#### **24. LOCATING TARGETS. a. Air methods compared with ground methods.** Air observation differs from ground observation with respect to the location of targets in the following particulars:

(1) Air observation permits less time for study of the target from any one position. The air observer must rely largely on experience and training to aid him in recognizing and locating targets without undue delay. His use of field glasses will in most cases be limited to target identification.

(2) The air observer is not limited to a small area for observation. If the target cannot be located

from one position, the air observer can move rapidly to a more advantageous position.

(3) Defilade seldom prevents observation from the air.

(4) A good map or photograph is essential to air observation due to the large area under surveillance. Targets will usually be referred to by grid coordinates.

**b. Types of targets.** The targets which the air observers will most frequently be called upon to locate are enemy artillery positions and tanks. Various methods of spotting are used. Both the pilot and observer look for—

- (1) The actual guns or tanks.
- (2) Gun flashes.
- (3) Cleared areas in woods or tree clumps.
- (4) Vehicles moving into an area.
- (5) Faulty camouflage.
- (6) Personnel activity.
- (7) Vehicular tracks in fields or paths converging on a point.
- (8) Gun positions identified on aerial photographs.

**c. Position for locating targets.** The best position for air observation is that position which permits adequate target identification and affords a reasonable degree of safety. This position will generally depend on the enemy's capabilities and the terrain. If the enemy's small arms fire is light, a position close to the target at a low altitude should prove most satisfactory. If hostile fighter planes and heavy caliber antiaircraft fire are not being encountered, Army Ground Forces aircraft may operate at higher altitudes. Flying in the vicinity of mountain

peaks and cloud bases should be avoided because they are often used as registration points by enemy antiaircraft artillery. Maneuvering for a good position from which to observe requires thorough knowledge of the situation by both the pilot and the observer. At times it is even possible to take a position directly over the target area. The flight path and altitude of the aircraft must be continually varied throughout the mission as a protective measure against enemy antiaircraft artillery.

## **25. ADJUSTING ARTILLERY FIRE. a. Targets.**

Since the position of the aircraft with respect to the target is constantly changing, the air observer must make allowances for variations in the target offset. Visualization of the gun-target line requires continuous practice, and is made more difficult by the fact that the guns being fired often cannot be seen from the position of observation. To prevent losing the target when the aircraft is maneuvered, a well defined reference point on the ground near the target is used.

**b. Bursts.** Location of bursts from the air may prove difficult because of the terrain. Smoke shells will produce bursts which are readily visible. As an aid to observer and pilot, the artillery unit fire-direction center may transmit the warning SPLASH, 5 seconds prior to the end of the time of flight of the projectile. A time-of-flight code is especially necessary when long range artillery is being adjusted, in order to give the pilot time to maneuver for a favorable position from which the burst can be observed.

c. Prearrangement and conduct of fire. See FM 6-40

**26. RECONNAISSANCE OF AREAS AND ROUTES OF MARCH; MARCH CONTROL.** a.

Reconnaissance of areas and routes of march. In addition to or in conjunction with information obtained from ground reconnaissance, unit commanders may wish to secure information readily obtainable by air reconnaissance, such as—

- (1) Alternate routes of approach and departure.
- (2) Condition of roads and bridges along the march route.
- (3) Assembly areas.
- (4) Defiladed areas.
- (5) Indications of mined areas.
- (6) Areas offering heaviest natural camouflage.
- (7) Broad view of the assigned sector.
- (8) Possible position areas (for artillery).

b. March control. (1) *Employment.* In many situations the unit commander can supervise movements and maintain effective march control from the air.

(2) *Requirements.* For marches over great distances, numerous landing strips must be available to permit refueling the aircraft or to return the commander or observer to the march column. The air section must carry sufficient fuel to refuel the aircraft en route. The aircraft must establish radio communication with the march column.

(3) *Limitations in combat.* (a) Suitable landing strips may not be available.

- (b) Adverse weather conditions may keep the aircraft on the ground.
- (c) Hostile air superiority may restrict the use of Army Ground Forces aircraft.
- (d) Marches cannot be controlled from the air at night.

**27. OBTAINING INFORMATION ON FRIENDLY AND HOSTILE FORCES.** a. General. Worth while information by air observation requires a definite objective, careful and frequent study of the terrain, and thorough knowledge of the situation. The observer and the pilot must know *why* they are being sent aloft, *what* they are to look for, *where* they may expect to find it, *how* they are to report it, and *when* they are to return. When a mission is completed the unit S-2 interrogates both the pilot and observer. The unit S-2 should make frequent aerial reconnaissances.

b. Information on friendly forces. The pilot and observer may be given the mission of locating or identifying—

- (1) Supported troops.
- (2) Front lines.
- (3) Enemy-laid mine fields within friendly territory. The mine field pattern may be identified by low-altitude observation of probable areas.
- (4) Progress and position of reconnaissance troops. Friendly troops may identify themselves by displaying panels or smoke at a prearranged time or signal. Radio communication with reconnaissance troops is established whenever possible.

c. Information on hostile forces. Due to the mobility of the aircraft and the opportunity it affords

for viewing ground objects from many different angles, the air observer can often provide better information than ground observers concerning the following items:

- (1) Enemy front lines.
- (2) Volume and direction of road traffic.
- (3) Indications of attack or withdrawal.
- (4) Signs of demolition work.
- (5) Appearance of new routes.
- (6) Condition of enemy-held roads and bridges.
- (7) Condition of rivers and river banks.
- (8) Location of enemy road blocks.

**28. PATROLS.** When it is required to keep an enemy sector under continual aerial observation, it will be found necessary to coordinate the air observation of more than one unit under the supervision of the appropriate commander. In view of the enemy tendency to curtail activity in the presence of Army Ground Forces aircraft it will be found advantageous to maintain a continuous aerial reconnaissance patrol in each sector when sufficient aircraft are available. Each aircraft patrols its sector for a predetermined period of time, at the end of which it is relieved in the air by another aircraft. In general, ten aircraft can maintain a one-aircraft patrol throughout the day in addition to performing their normal missions. During a patrol tour, a complete intelligence report is recorded by the observer and targets of opportunity are taken under fire.

**29. AERIAL PHOTOGRAPHY.** a. **General.** Photographs taken from Army Ground Forces aircraft at comparatively low altitudes often have great tactical value. At times weather conditions may prohibit high performance aircraft from flying, whereas light aircraft can take advantage of a temporary break in the weather to obtain urgently needed photographs of certain areas.

b. **Equipment.** The lightweight hand-held K-20 aircraft camera is the most satisfactory of present equipment. Arrangements should be made for processing the film in order to make the finished print available in the least possible time.

c. **Operation.** (1) The success of the photographic mission will depend to a large degree on the planning done before the mission. In addition to a thorough understanding of the areas to be photographed, and the desired views, a system of recording pertinent information on each photograph must be devised. Information provided includes a designation of center foreground, position from which the photo was taken, and other information which will help in future orientation.

(2) The position and altitude of the aircraft when the photograph is taken will depend on the tactical requirements and will be limited by enemy capabilities.

(3) The operation of the K-20 aerial camera is simple and differs little from that of an ordinary commercial camera. Observers should be trained to operate the K-20 camera and to process the film in case of emergency. A fast shutter speed is used to prevent blurring.

**30. CAMOUFLAGE INSPECTION FLIGHTS.**  
Army Ground Forces aircraft are extremely useful for inspecting camouflage and camouflage discipline of friendly troops. A camouflage inspection flight by the unit commander or his representative should be made as soon as the unit is in position.

## CHAPTER 4

### SPECIAL MISSIONS AND OPERATIONS

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**31. EMERGENCY AIR SUPPLY.** **a. General.** During an emergency, Army Ground Forces aircraft may be utilized to drop supplies to isolated units when other means of transportation cannot be used. Army Ground Forces aircraft should not be used for a supply mission when cargo type aircraft can accomplish the mission. Since low-flying liaison aircraft present an extremely vulnerable target to enemy ground fire due to their slow speed and lack of armor, aerial supply missions involving Army Ground Forces aircraft are attempted *only* if no other means can be used to accomplish the mission.

**b. Employment.** The slow speed and maneuverability of liaison aircraft permit great accuracy in hitting small drop areas which might be occupied by isolated outposts. These isolated positions are more easily and accurately located by liaison aircraft than by heavier aircraft less suited for observation. Liaison aircraft can carry only a small load in comparison with cargo aircraft. This characteristic limits liaison aircraft to supplying only small units for short periods of time. Resupply missions may prevent Army Ground Forces aircraft from performing more important missions. In most

cases it will prove impracticable to attempt to supply units by liaison aircraft when the aircraft will have to fly over well organized enemy-held terrain. The drop area should be marked with panels, pyrotechnics, or smoke. Radio contact between the aircraft and the isolated unit is desirable and is arranged whenever possible.

**c. Weight and distribution of load.** The weight of supplies which may be carried depends on the type of aircraft and the length and altitude of the landing strip. The flying characteristics of the aircraft will be affected more by the distribution of weight than by the weight itself. The weight must be distributed so that it remains within the center of gravity limits as specified in the Army Air Forces Technical Orders pertaining to the aircraft. Carrying the load suspended from a combination of racks installed on the wings and the fuselage is recommended. These same racks may be used for carrying bombardment flares for night observation as described in paragraph 32.

**d. Equipment.** Efficient air supply by liaison aircraft requires the use and installation of special equipment. In some cases standard issue equipment may be adapted, while in others, specially fabricated equipment will prove more satisfactory.

(1) Light capacity exterior bomb racks issued by the Air Forces are recommended. Mechanically operated racks are more satisfactory than those electrically operated. Fabrication of special racks may be desirable in some installations such as a fuselage rack where the load must be carried flush with the belly of the aircraft to prevent the load from dragging on the ground while taxiing.

(2) Standard Air Forces paracrates are satisfactory. Light weight and adaptability are to be considered as well as the importance of keeping drag to a minimum.

(3) Standard Air Forces equipment parachutes may be used. However, the static line should be shortened from 15 feet to not less than 6 feet to reduce the shock imparted to the aircraft when the parachute is opened. A safety release in the static line should be devised whereby the load and the static line can be jettisoned if the static line becomes fouled.

e. **Precautions.** (1) Pilots should receive training in flying heavily loaded liaison aircraft. A runway at least 2,000 feet long should be used until the pilots become thoroughly familiar with the performance of the heavily loaded aircraft.

(2) Liaison aircraft when heavily loaded are much less maneuverable, therefore if turbulent air is anticipated or if the drop area is difficult to approach, the load must be reduced correspondingly.

f. **Loading.** Typical loading for liaison aircraft is similar to that shown for the L-5E in figure 15. The wing loads weigh 200 pounds each and are carried on exterior bomb racks, type B-7. The load carried inside the fuselage weighs 200 pounds and is ejected by means of a specially fabricated device. This is considered to be the maximum safe load which may be carried by the L-5 aircraft. The racks mounted at the jury strut fittings are used in the event that several small loads must be carried; they may also be used for carrying flares.

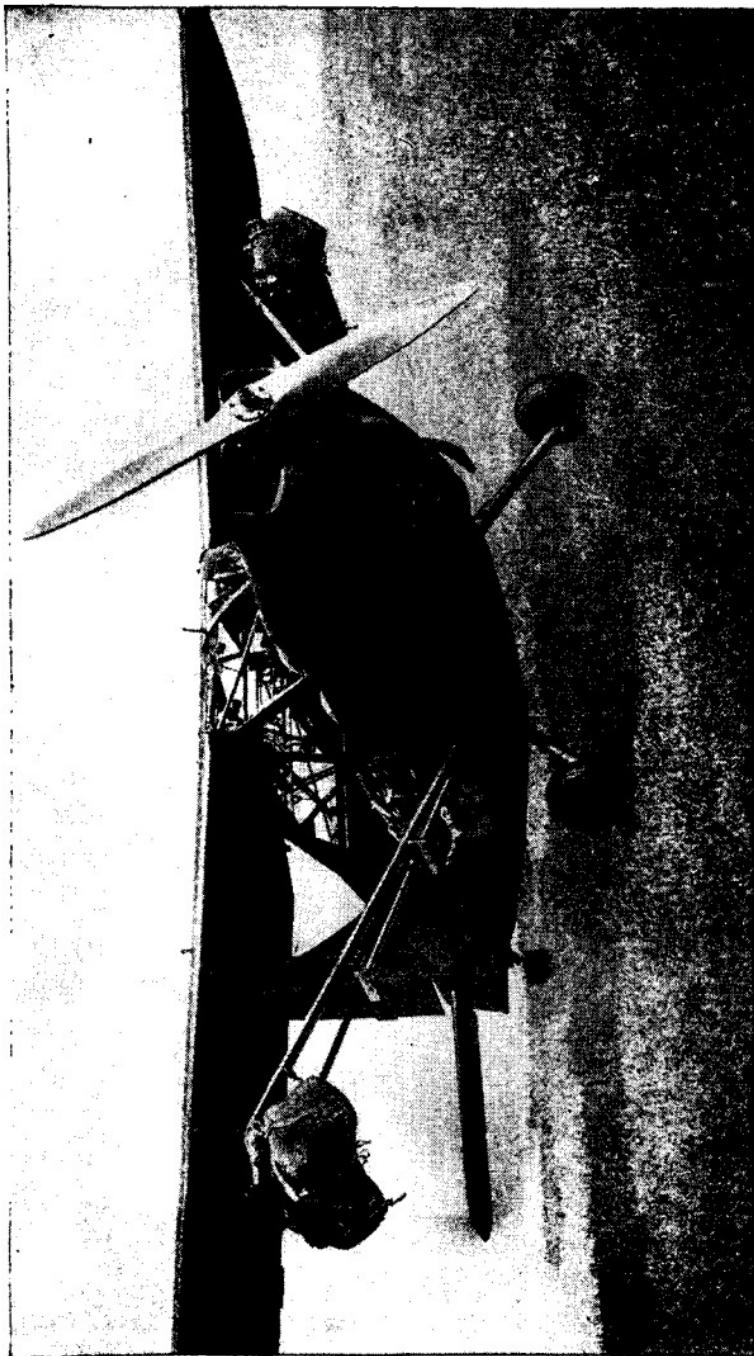


Figure 15. L-5E loaded for supply mission.

**32. NIGHT OPERATIONS.** *a. General.* Provided the pilot and observer have been sufficiently trained in night flying, Army Ground Forces aircraft can be used effectively at night. Daylight reconnaissance and map reconnaissance are necessary to aid the pilot and observer in remaining oriented at night. Terrain features and road nets are clearly visible on moonlight nights. However, on dark nights, illuminating shell and aircraft parachute flares such as the M9 reconnaissance flare and the M26 bombardment flare may be used to illuminate the desired area. White phosphorus ammunition may be used to mark check points.

*b. Employment.* Missions are flown from 1,500 feet to 7,500 feet directly over the desired area. The altitude flown is high enough to take maximum advantage of the natural and artificial light.

(1) *Artillery fire missions.* (a) *Registrations.* Base point and check point registrations and center of impact missions may be fired at road junctions or prominent terrain features to obtain corrections for unobserved fires.

(b) *Harassment and neutralization.* Activity on roads and in assembly areas can be picked up by the flash of lights or by the flashes of small arms fire.

(c) *Counterbattery.* Active gun batteries are clearly revealed by the flashes made by their weapons. The observer must orient the location of the flashes with respect to visible terrain features so that he will not lose the location.

(d) *Interdiction.* Roads, road junctions, streams, and bridges show up clearly enough from the air

to be taken under fire by artillery. These terrain features are visible with the moon in a phase from half to full and are easily seen in the light of illuminating shells and parachute flares on dark nights.

(2) *Intelligence missions.* General information concerning movements and road traffic may be obtained.

c. **Requirements for night operations.** In combat, the importance of the night mission to be performed must be weighed against the additional hazards encountered.

(1) *Coordination with other units and Army Air Forces.* Careful coordination must be achieved in advance of the mission in order to acquaint friendly antiaircraft artillery, air forces, and ground forces with the area, time, altitude, type of aircraft, and the mission to be accomplished by night. Failure to obtain complete coordination means almost certain loss of the pilot, observer, and aircraft. Plans for all night flights must be coordinated through air liaison channels with the appropriate tactical air command. The observer and pilot are informed of all anticipated friendly firing within the zone of observation. At night shell bursts and gun flashes may appear similar from the air. The observer should know where friendly fire will be falling so that he will not confuse friendly shell bursts with enemy gun flashes. When aircraft from several units are operating at night in the same sector, the flights are coordinated through the appropriate command in the sector to avoid collisions. The air officer of this command may designate different altitudes at which the aircraft of different units will operate.

(2) *Landing fields.* Night operations cannot normally be carried on from fields in the immediate forward areas within range of enemy artillery. However, they can be carried on from longer landing fields which should be available farther to the rear. The tactical situation and terrain may require operation from darkened fields. This can be effected by lighting the fields with such equipment as portable field lighting sets, flare pots, or flashlights with improvised covers which shield the light except from the direction of approach. Figure 10 shows a method of lighting a field for night flying during combat.

(3) *Aircraft equipment.* The aircraft should be equipped with luminous instruments, one of which is a bank and turn indicator. Position lights should not be used in combat flying but must be used in all other operations. A flare gun for firing signal and illuminating flares and bomb racks for carrying and releasing the larger type flares may be required. (See fig. 15.) A dim red light is required by the pilot and observer in order to read maps and aerial photographs, and record information.

(4) *Pilot and observer.* The added difficulties encountered in night operations make the use of an observer imperative, and the need for a coordinated pilot-observer team is even more essential than during daylight flying. Extensive and continuous night flying is necessary for both the pilot and observer to develop and retain their ability to see and work together at night. Night reconnaissance missions flown over known areas are of great value in familiarizing them with the nighttime appearance of roads, buildings, gun flashes, and terrain fea-

tures. Maximum prearrangement of missions should be practiced so that reference to maps or other information will be reduced to a minimum because reading, even by a dim red light, greatly impairs night vision. Observer training applicable to night observation must be conducted to obtain results.

**33. AIRBORNE OPERATIONS (FM 31-30).** a. Army Ground Forces light aviation personnel assigned to airborne units should be trained thoroughly in the basic techniques applicable to organic aviation of their several arms. In addition, specialized training in airborne tactics and technique must be given.

b. Because of the complex nature of airborne operations, varied types of terrain, distances involved, and special missions, light aviation personnel should undergo further special training prior to each operation.

c. Light aviation personnel must have a thorough knowledge of the mission, plan of attack, plan of supply, and means of communication of each operation in order to carry out their assigned missions without undue losses of personnel and aircraft.

d. Light aviation has proved extremely valuable in maintaining control of widely scattered airborne units during airborne operations. Every effort should be made to provide commanders with light aviation during the initial assembly of airborne troops.

e. If the range of the operation is over half of the cruising range of the organic light aviation, special arrangements should be made to transport

the aircraft to the combat area. The light aircraft may be towed behind the troop carriers or disassembled and carried in cargo aircraft.

**34. AMPHIBIOUS OPERATIONS.** **a. General.** In the initial stages of amphibious operations, Army Ground Forces aircraft may be employed not only in their normal role but also in the adjustment of naval gunfire and for directing landing parties. The aircraft may be sent ashore at any time depending on their role in the operation. Regardless of the method used to move the aircraft ashore, if they are intended for use in the early stages of the operation, the pilots and observers must be thoroughly briefed before loading. Complete briefing is absolutely necessary because in the first hours of an amphibious landing, close liaison between aircraft and the unit is almost impossible to maintain. The pilot and observer must have a clear conception of the situation in order to carry out successfully their mission on their own initiative. The details of briefing will depend on the missions assigned to the aircraft and the experience of the pilot and observer. Briefing will include:

- (1) Units for which the aircraft will provide air observation, such as naval shore fire-control parties, landing party commanders, as well as the parent units.
- (2) Complete information concerning the means of communication and call signs of each unit.
- (3) Information concerning likely enemy counter-attacks.
- (4) Plan of attack of friendly troops.

(5) Overlays, maps, or photographs showing enemy installations, especially those likely to require reduction by naval or artillery fire. Since it is not practicable to use an overlay in the aircraft, such installations should be shown directly on a map or aerial photograph.

**b. Plans.** Unit plans for an amphibious operation include the following:

(1) The immediate mission of the air section.

(2) The number of aircraft and the equipment needed. A unit will very likely require only half of its air section initially and can have the second half brought in with later elements.

(3) The location of the first landing strip should be prearranged, as nearly as possible, by a study of available maps, aerial photographs, and intelligence reports.

(4) The equipment and supplies of the air section will be limited by the amount of transportation available.

(5) If the aircraft are brought ashore disassembled, the ground crew with necessary supplies and equipment must accompany the aircraft. If the aircraft are to be flown in, arrangements must be made to have the ground crew and the air section vehicles ashore as soon as possible to prepare and operate the landing strip.

**c. Transporting disassembled aircraft to beach-head by boat.** (1) Several types of landing craft are suitable for transporting Army Ground Forces aircraft, some of which are the LST (landing ship, tank), the LCM (landing craft, mechanized), and the LCT (landing craft, tank). Disassembled aircraft can be loaded directly on the landing craft

or may be mounted on a truck or trailer which is loaded aboard the landing craft.

(2) If the aircraft is disassembled and loaded onto a landing craft, considerable difficulty will be experienced in unloading and transporting the aircraft to the assembly area. If circumstances require that the aircraft be loaded directly onto the landing craft, the wings should be attached alongside the fuselage in order that the aircraft may be towed as a unit behind a vehicle.

(3) The L-4 aircraft may be loaded very satisfactorily upon a 2½-ton long wheel base truck as shown in figure 16. If the landing craft is to be of the LST type, a long wheel base truck must be used, and the rudder of each aircraft must be removed to permit clearance of the entrance of this type of landing ship. In the case of the L-5 type aircraft, a better solution is to load the wings and horizontal stabilizer in a truck and to tow the fuselage behind the truck.

(4) A 1-ton trailer can be converted to carry a disassembled aircraft by removing the body of the trailer.

(5) The loading of the aircraft will vary with the materials available. Usually it will be found that mounting the wings at the strut and spar butt fittings on hangar type jigs is more satisfactory than using cradle type jigs. (See figs. 16 and 17.) Disassembly should be kept to a minimum since the time for reassembly may be limited.

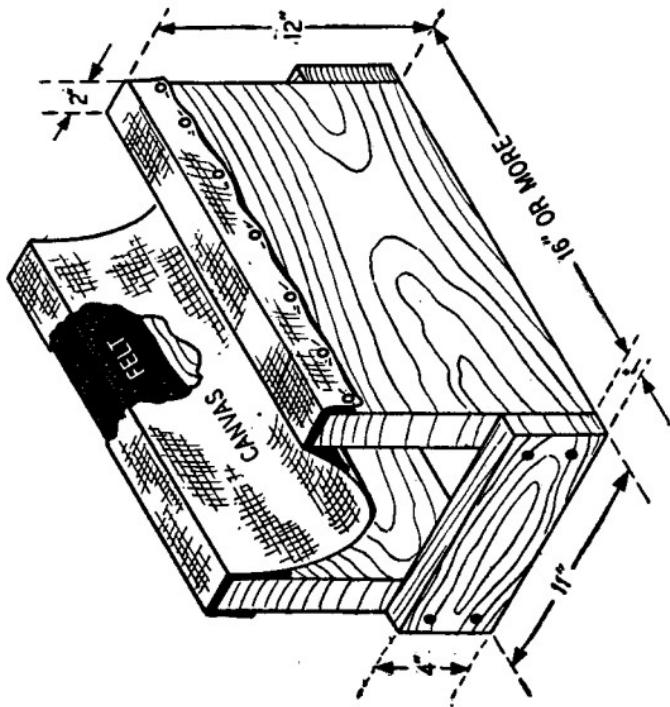
**d. Flying aircraft from LST equipped with Brodie device.** (See App. IV.) This method is highly desirable from a tactical viewpoint because the aircraft may be launched at any time in the opera-

LOADING COMPLETE AIRPLANE  
2 1/2 TON EX6 TRUCK LONG WHEEL BASE



Figure 16. Loading aircraft for an amphibious operation.

## CRADLE TYPE



## HANGER TYPE

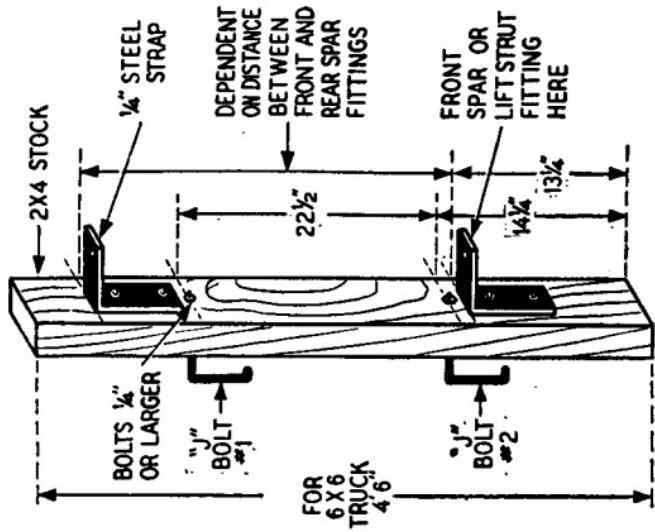


Figure 17. Wing jigs for loading wings on cargo truck or trailer.

tion and close liaison can be maintained with the landing forces by the ship's radio. Reports from combat operations indicate that it is impracticable to use a naval aircraft carrier, because for tactical reasons the aircraft carrier must remain too far off shore to allow Army Ground forces aircraft to be flown in on schedule. In practically every operation where LST's have been used as Army Ground Forces aircraft carriers, the aircraft were available at any time during the landing.

**e. Use of seaplane floats.** When seaplane floats for Army Ground Forces aircraft are available, these aircraft may be used effectively in amphibious operations. The aircraft can be deck-loaded on any vessel equipped with a boom for lowering the aircraft over the side for take-off. Because of the light construction of the aircraft, operation in heavy seas is impossible. Also, great difficulty would be encountered in lowering the aircraft over the side of a ship during heavy seas without damaging it beyond repair.

**f. Land based operations.** Flying Army Ground Forces aircraft from a nearby land base is practicable only when the over-water distance is less than half of the cruising range of the aircraft. The most difficult problem is establishing and maintaining communication between the landing units and the aircraft at the land base.

**g. Life preservers.** During amphibious operations and whenever flying over large bodies of water, the pilot and observer should wear life preserver vests and one-man life rafts attached to the parachutes.

**35. JUNGLE OPERATIONS (FM 72-20).** The dense growth typical of the jungle restricts ground observation and increases the need for effective air observation.

**a. Employment of the aircraft.** Most long-range artillery firing, including counterbattery, must be conducted from the air. Infantry mortars and chemical mortars may also be adjusted. The difficulties encountered in ground travel may require the use of aircraft to drop messages to patrols and forward observers. In extreme emergencies, ammunition and supplies may also be dropped to ground units. Security patrols by aircraft may be used to great advantage.

**b. Target location and observation.** Locating and observing targets in the jungle may be difficult. For the most part, missions have to be flown at extremely low altitudes, often directly over the targets. It is desirable to adjust with smoke shell.

**c. Landing fields.** Swamps and heavy jungle growth limit the number of landing fields available. Often Army Ground Forces aircraft will be required to operate from advance bases of high performance aircraft. Landing strips in the vicinity of the units may have to be cleared and constructed with heavy engineer equipment. Pontoon-equipped aircraft may use streams or lakes. Long-range radio equipment may be required to maintain communication between the unit command post and the landing field.

**d. Displacements.** The scarcity of landing fields may prevent the air section from displacing with its unit. It may continue to operate from a con-

venient rear base even though the unit displaces repeatedly.

**e. Maintenance.** (1) Metal members of the aircraft may rust. They should be checked carefully and refinished when necessary.

(2) Spars and other wooden parts of the aircraft may warp and rot. These should be subject to regular inspections. Wings should be checked frequently for rigging.

**f. Survival kits.** When the air section is operating in the jungle, each aircraft should be equipped with an Army Air Forces survival kit for use by the pilot and observer in the event that the aircraft is forced down in an isolated area.

**36. DESERT OPERATIONS (FM 31-25).** **a. Observation.** Over treeless and flat desert terrain, air observation is excellent. Targets can be located easily. Most missions can be conducted from a very low altitude behind friendly lines. Precautions must be taken not to disclose the location of the landing field by repeatedly following the same flight path in its vicinity.

**b. Additional types of employment.** (1) The distance between units is frequently so great that Army Ground Forces aircraft may become an extremely important means of communication and control.

(2) Security patrols may be used to watch over exposed flanks. On approach marches, the aircraft should be employed for reporting the location and movement of the enemy.

**c. Displacements.** In the desert, displacements cover relatively great distances. Pilots must be

prepared to fly 75 miles or more at low altitudes. When the unit displaces at night, the aircraft may be unable to rejoin it until the next day.

**d. Concealment.** Desert terrain provides scant concealment or camouflage for the aircraft and equipment. The aircraft are more easily located by enemy fighters and evasive action is far more difficult due to lack of terrain features to afford protection. Improvements to landing fields which will facilitate location by enemy air observation must be avoided. Alternate fields to the rear should be selected and improved. In fluid operations, it may be necessary to fly the aircraft to the alternate field, remain overnight and return to the forward field the next morning. The use of an alternate field may prevent losing aircraft if the unit should withdraw during the night. Aircraft, vehicles, and equipment must be widely dispersed, and their outlines broken by use of camouflage nets which blend with the terrain, or any other means available.

**e. Maintenance.** Heat, sand, and wind complicate the problem of maintenance in the desert. The fabric of the aircraft may require frequent rejuvenation with coats of dope. Oil must often be changed after 8 or 10 hours of operation. Wooden members such as spars may crack and warp. Frequent inspections of all wooden members are necessary to prevent structural failures in flight.

### **37. MOUNTAIN OPERATIONS (FM 70-10). a. Employment of Army Ground Forces aircraft. (1)**

Because of the difficulties involved in ground reconnaissance, aircraft will be used frequently for reconnaissance of position areas and routes of march.

(2) Hostile artillery, mortars, and assembly areas concealed from ground observation by intervening ground forms may be observed from the air.

(3) Courier and liaison missions may be frequent.

(4) In extreme emergencies, the aircraft may be used to drop supplies to personnel isolated on mountains or in positions temporarily inaccessible to normal ground supply agencies.

**b. Operational problems.** Pilots will have to fly at unusually high altitudes, diving for mountain tops, as a means of defense, when attacked by enemy aircraft. Care must be exercised to stay clear of the trajectories of artillery projectiles. Because of distance and terrain factors, it will seldom be possible for the observer or pilot to remain at the unit command post. Briefing of the pilot and observer may be carried on by telephone. An accurate situation map must be kept at the landing field.

**c. Communication.** Because of increased distances and mountainous terrain, a strong base radio set is needed at the landing fields for communicating with the unit command post and the aircraft aloft. It may often be necessary to use relay stations. When direct wire communication with the unit is impracticable, lines may be laid to a switching central.

**d. Landing fields.** Landing fields in mountainous terrain are scarce. It may often be desirable for the aircraft of several units to operate from the same landing field.

**38. DIRECTION OF AIR STRIKES AND STRAFING MISSIONS ("HORSEFLY" OPERATIONS) (FM 31-35).** Liaison aircraft of the L-5 type are very useful to facilitate and direct air strikes and strafing missions. These aircraft are used to locate enemy targets suitable for attack by fighter-bombers, to request fighter-bomber attacks upon targets of opportunity, to lead the fighter-bombers to the target area by direct radio communication with the fighter-bombers, and to identify the target to the fighter-bomber pilots in order to obtain maximum effect. The upper surfaces of the wings of the liaison aircraft are generally painted red, yellow, white, or purple to assist the fighter-bomber pilots in recognizing the aircraft, thus affording additional protection against the possibility of mistaken identity and resultant fire or bombing upon friendly troops. The liaison aircraft are flown by experienced fighter-bomber pilots. In order to obtain assistance from the field artillery in immobilizing the target and neutralizing enemy antiaircraft fire during a fighter-bomber attack, a field artillery pilot or observer often flies in the liaison aircraft with the fighter-bomber pilot to direct artillery fire upon the target or enemy antiaircraft positions prior to, during, and after the fighter-bomber attack. The liaison aircraft and maintenance personnel are provided by the Army Air Forces and are generally based at corps landing fields.

## CHAPTER 5

### SUPPLY, ADMINISTRATION, MAINTENANCE, AND FLYING REGULATIONS

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**39. SUPPLY.** a. General. The air section is an organic part of the unit and should obtain all its equipment and supplies through normal supply channels. The superior unit air officer assists the air sections of subordinate units in the procurement and distribution of Army Air Forces supplies.

b: In continental United States. (1) The Commanding General, Army Air Forces, is responsible for the supply and third and fourth echelon maintenance of Army Air Forces equipment issued to Army Ground Forces units. In each area an Army Air Forces activity is designated to provide supplies and higher echelon maintenance for Army Ground Forces units.

(2) Initial issue of authorized allowances of Army Air Forces equipment and supplies to Army Ground Forces units is automatic, except liaison aircraft.

(3) Requests for initial and replacement aircraft are made through command channels to the Commanding General, Army Ground Forces.

c. In oversea theaters. Army Air Forces equipment and third and fourth echelon maintenance

thereof are furnished Army Ground Forces units by the Army Air Forces Depot Unit, Army.

**40. ADMINISTRATION.** **a. General.** The senior pilot of each unit is responsible to the unit commander for the proper handling of the required Army Air Forces forms and records. Each unit air section should have a complete file of appropriate Army Air Forces Technical Orders and Regulations pertaining to maintenance and operation of the aircraft.

**b. Forms and records.** (1) The following records will be kept by each unit air section in accordance with applicable Army Air Forces Technical Orders and Regulations:

<i>AAF Form No.</i>	<i>Title</i>
1	Flight Report—Operations.
1A	Flight Report—Engineering.
5	Individual Flight Record.
41B	Aircraft Maintenance Inspection Record.
46	Parachute Log Record.
60A	Technical Instruction Compliance Record (Aircraft).
60B	Technical Instruction Compliance Record (Engines).
61	Propeller Historical Record.
263	Aircraft Checker's Report.

(2) The senior pilot is responsible for the completion of Army Air Forces Forms 1, 1A, 41B, 46, 60A, 60B, and 61.

(3) In accordance with AAF Regulation 15-5, Army Air Forces Form 5 will be kept in duplicate for each pilot. The senior pilot is charged with the

correct transcription of flight time from Army Air Forces Form 1 to the Army Air Forces Form 5 of the pilot concerned. At the end of the month, the senior pilot will certify to the correctness of each Army Air Forces Form 5. The original is filed in the 201 file of the individual concerned, along with copies of all orders affecting the flying status of the individual. The carbon copy, certified as to correctness by the senior pilot, is furnished the pilot for his personal records. When a pilot is transferred to another unit, his Army Air Forces Forms 5 and the file of orders affecting his flying status will accompany him. In case of the pilot's death or relief from flying status or active duty, this file will be forwarded through channels to The Adjutant General.

c. **Accident reports.** Reports of major aircraft accidents and damage are made as prescribed in AR 95-120 and current instructions from the Commanding General, Army Ground Forces. No report is required of accidents involving only minor damage to aircraft.

d. **Inspection and disposal of records.** Unit commanders may authorize the inspection and destruction of flight records after they have been kept the length of time required by Army Air Forces Regulations.

e. **Unsatisfactory report.** (1) It is of utmost importance that a report be submitted on any article of Army Air Forces equipment which is not satisfactory for any of the reasons below:

(a) Failures or malfunctioning of any item of Army Air Forces matériel or equipment.

(b) Unsatisfactory design of any item supplied by Army Air Forces.

(c) Defects due to faulty matériel, workmanship, or inspection.

(d) Unsatisfactory maintenance methods prescribed in Army Air Forces technical publications.

(2) It is emphasized that, since the Army Air Forces Form 54 (Unsatisfactory Report) is one of the chief indications of the performance of equipment under field conditions, units in the field should be especially alert to report *all* deficiencies so that corrective action may be taken. Unsatisfactory reports should be prepared and forwarded as prescribed in Army Air Forces Regulation 15-54. One copy will be sent to the Commanding General, Army Ground Forces.

f. **Physical fitness of pilots.** (1) *General.* Unit commanders are responsible for the physical fitness for flying of their pilots. Unit commanders will be guided in their actions regarding the maintenance of the physical well-being of pilots by the recommendations of the unit surgeon. Unit surgeons may communicate with flight surgeons and aviation medical examiners of the most accessible Army Air Forces installation or unit on matters concerning aviation medicine and the care of flying personnel. Army Air Forces flight surgeons and aviation medical examiners will render technical advice and assistance in the care of Army Ground Forces pilots when requested to do so by unit surgeons.

(2) *Pilot fatigue.* To avoid accidents caused by "pilot error," each pilot must be in good physical condition. An excessive amount of flying will produce "pilot fatigue" which is evidenced by the pilot

or the observer becoming extremely nervous, apprehensive, irritable, or careless. The pilot or the observer may lose his appetite, he may have difficulty sleeping, and may have nightmares. If the individual is allowed to continue flying, a serious accident will inevitably result. In combat, pilots and observers should be rested at frequent and regular intervals by complete relief from flying duty for short periods of temporary duty at a rest area away from the unit. This procedure will result in more efficient observation, safer flying, and higher morale among air section personnel.

(3) *Physical examinations for flying.* Standards of physical examinations for flying are prescribed in AR 40-110. All physical examinations for flying will be conducted by flight surgeons or aviation medical examiners certified by the Commanding General, Army Air Forces, as currently qualified to perform such examinations. All Army Ground Forces pilots holding an effective aeronautical rating and currently on active flying status will be given a physical examination for flying in the first 2 months of each year. Physical examinations will be conducted by Army Air Forces flight surgeons and aviation medical examiners only upon oral or written request of the unit commander or unit surgeon.

**g. Relief from and restoration to flying status.**

(1) *General.* Suspensions and removal of suspensions from flying status are accomplished in accordance with the provisions of AR 35-1480. The Commanding General, Army Ground Forces, and the commanding generals of oversea theaters of operations having Army Ground Forces pilots as-

signed to their commands are authorized to confirm suspensions from flying status and revocations of suspensions from flying status of liaison pilots.

(2) *Relief from flying status.* A commanding officer will suspend from flying status any individual of his command who, in his opinion, is unfit for flying, except when the unfitness is the result of an aviation accident (AR 35-1480). In case of an aircraft accident, no suspension of flying status will be accomplished until a period of 3 months has elapsed subsequent to the month in which the individual last met flight requirements. In recommending removal from flying status, the type of suspension will be determined by estimating the approximate period of time the individual will be unable to perform flying duties. Each recommendation will indicate definitely the period of suspension, i.e., "grounding" for periods under 30 days and "suspension" for periods over 30 days. Relief from flying status will be accomplished in the following manner:

(a) "Grounding" will be relief from flying status for a period not expected to exceed 30 days and which is imposed because of a minor illness or injury, as defined in AR 40-110, and not the result of an aircraft accident. The commanding officer of a unit will ground an individual upon advice of the unit surgeon without reference to higher authority. Such action will be accomplished by written order of the unit commander. When a grounding order by the commander of a unit exceeds a period of 30 days, such grounding will become a "suspension" and will be reported for confirmation as indicated below.

(b) "Suspension" will be relief from flying status for a period expected to exceed 30 days. It will be accomplished by written order of the unit commander. In all cases such action, with reasons therefor, will be reported for confirmation to the Commanding General, Army Ground Forces, or to the theater commander concerned.

(3) Restoration of flying status will be accomplished in the following manner:

(a) Removal of grounding will be accomplished by written order of the commanding officer of the unit, upon the recommendation of the unit surgeon, without reference to a higher authority.

(b) Removal of suspension from flying status will be accomplished by written order of the unit commander when, in his opinion, the individual so suspended again becomes fit for flying. This action, with reasons therefor, will be reported for confirmation to the authority who confirmed the suspension from flying. Removal of suspension from flying status resulting from physical disqualifications will be initiated when an Army Air Forces flight surgeon or aviation medical examiner has found the individual physically qualified for flying. If a pilot has been suspended from flying for a period longer than 6 months, the pilot must appear before a flying evaluation board, in accordance with the provisions contained in h below, prior to being restored to flying status.

**h. Evaluation of pilots.** If a unit commander questions the flying ability of a pilot assigned to his unit, the pilot may be ordered on detached service to the nearest Army Air Forces station for the purpose of appearing before a flying evaluation

board. The flying evaluation board will be conducted in accordance with pertinent Army Air Forces regulations. Complete details regarding the flying deficiency of the individual concerned will be furnished the flying evaluation board by the unit commander. The flying evaluation board proceedings and recommendations will be submitted through Army Air Forces command channels to the Commanding General, Army Air Forces. The Commanding General, Army Air Forces, will place his recommendations thereon and forward the report to the Commanding General, Army Ground Forces who will direct final action in all such cases.

i. **Medical records of flying personnel.** (1) The medical records peculiar to the evaluation of an individual in regard to flying will be maintained in a complete chronological file and termed "64 file." It will normally consist of copies of the WD AGO Form 64 recording the results of annual and special physical examinations, records of groundings and suspensions, and abstracts of hospitalization when indicated. The surgeon of the unit to which the individual is assigned or attached for flying will be responsible for the maintenance of the 64 files.

(2) Upon transfer of an individual on flying status to another unit or installation, the surgeon responsible for the maintenance of the individual's 64 file will place the file in a sealed envelope clearly labeling the exterior with name, rank, and serial number of the individual concerned and the statement that the 64 file is included. The 64 file will then be included in the individual's field 201 file. When the field 201 file is received by the com-

manding officer of the unit or installation to which the individual is reassigned, the 64 file will be given to the surgeon of the new unit for custody. Whenever an individual is transferred overseas, the 64 file will be forwarded to the oversea destination.

(3) Whenever an individual is indefinitely suspended from flying, the 64 file will be incorporated with other medical records incident to the field 201 file. In the event of subsequent reinstatement on flying status, the material which originally comprised the 64 file will be extracted and formulated into a new 64 file.

(4) The normal confidential nature of medical records will be guarded by strict compliance with sealing of such records during transmission. However, such records will not be classified except in accordance with the provisions of AR 380-5.

(5) In the continental United States, reports of physical examination for flying will be forwarded by Army Air Forces flight surgeons or aviation medical examiners, in triplicate, direct to the Commanding General, Army Air Forces, for certification. The unit to which the pilot is assigned will be clearly indicated thereon. Certified copies and appropriate recommendations will be returned by the Commanding General, Army Air Forces, to the unit commander through the Commanding General, Army Ground Forces.

(6) In theaters of operations, reports of physical examinations for flying will be forwarded for certification to the commanding general of the theater air force. The unit to which the pilot is assigned will be clearly indicated thereon. Certified reports and recommendations will be returned by the

theater air force commander to the commanding officer of the unit to which the pilot is assigned, through the theater commander.

**41. MAINTENANCE.** **a. General.** The unit commander is responsible for the first and second echelon maintenance of the aircraft assigned to the unit. The term "first and second echelon maintenance" includes all repairs and maintenance which the unit is capable of performing with the personnel, tools, equipment, spare parts, and supplies available to it. Pilots should be capable of performing first and second echelon maintenance in emergencies. The mechanics should be graduates of the Army Ground Forces Air Mechanic Course. Supplies needed for first and second echelon repairs are generally furnished by the Army Air Forces Depot Unit, Army, supporting the command to which the unit is assigned or attached. Each unit is authorized by its Tables of Equipment a kit of supplies necessary for the proper daily maintenance of its aircraft. Spare parts for the repair of aircraft are available to the unit from the stock carried by the air section of the next higher headquarters or at the Army Air Forces Depot Unit, Army. Third and fourth echelon maintenance of Army Ground Forces aircraft are the responsibility of Army Air Forces. Normally third and fourth echelon maintenance will be performed by Army Air Forces Depot Unit, Army, which also furnishes replacement aircraft.

**b. Aircraft inspections and records.** (1) The following aircraft inspections will be conducted in

accordance with Army Air Forces Technical Order 00-20A:

- Preflight.
- Daily flight.
- 25-hour.
- 50-hour.
- 100-hour.
- At engine change.
- 25 hours after engine change.

(2) Records required by Army Air Forces Technical Order 00-20A will be kept as directed in those orders.

c. **Principles governing maintenance.** Aircraft are maintained in accordance with Army Air Forces Technical Orders, maintenance instructions, and service manuals pertaining to the aircraft.

d. **Transfer of forms and records.** When an aircraft or engine is delivered or transferred to another unit, its Army Air Forces Forms 41B, 60A, 60B, 61, and its complete historical data must accompany the aircraft or engine.

e. **Gasoline and oil.** (1) Standard aviation gasoline, preferably of 73 octane rating, should be used when available. The ordinary 80 octane automotive gasoline should be used in Army Ground Forces aircraft only in emergencies. Continued use of 80 octane automotive gasoline causes excessive carbon and lead deposit around the valve stems resulting in a loss of power and making frequent engine overhauls necessary. In the field, all gasoline should be strained through a chamois to remove water and other foreign matter.

(2) Standard aviation lubricating oils prescribed by Army Air Forces Technical Orders for the air-

craft engine must be used. Detergent automotive oils should not be used because they may clog the oil passages in the engine and cause engine failure.

**f. Unserviceable aircraft.** Aircraft and other items of Army Air Forces property which become unserviceable should be turned in to the Army Air Forces Depot Unit, Army.

**42. FLYING REGULATIONS.** The rules set forth in this paragraph, and in paragraphs 43 and 44 should be rigidly followed in training, and in combat to the extent practicable under the circumstances.

**a. Traffic pattern.** (1) The traffic pattern over a landing field should consist of a single counter-clockwise rectangular pattern at an altitude of 500 feet and extending approximately 2,000 feet outside the boundaries of the landing field. (See fig. 18.)

(2) Two legs of the pattern will be parallel to the wind direction, as indicated by the wind "T" and the other two legs will be perpendicular to the wind direction.

(3) Aircraft will enter the traffic pattern at approximately the center of the upwind or downwind leg, at 500 feet altitude and at an angle of 45° to the leg entered, with a 45° turn to the right. Aircraft will then continue in the pattern. On the base leg, they will make a 90° turn to the left for final approach on a straight line into the wind.

(4) Take-offs will be made into the wind as indicated by the wind "T" or as nearly so as possible. Take-offs over buildings or similar obstructions should be avoided whenever possible. After taking off, the aircraft will continue in straight

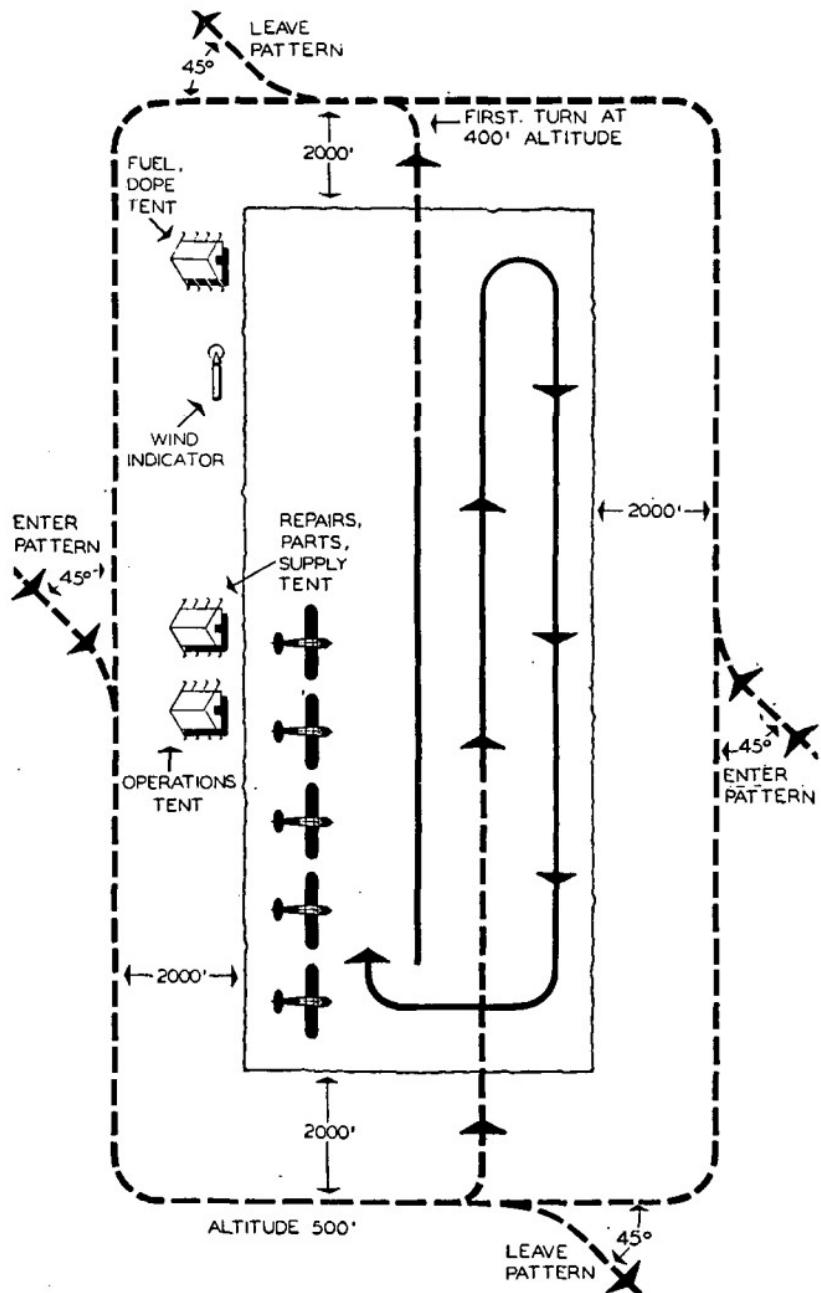


Figure 18. Local traffic pattern.

flight climbing to an altitude of 400 feet, where it will make a 90° turn to the left. Aircraft may leave the traffic pattern on either of the cross-wind legs at 500 feet altitude by making a 45° turn to the right, out of the pattern.

**b. Local flying area.** The local flying area should be designated by the unit commander as prescribed in AR 95-15.

**c. Danger and caution areas.** Each pilot is responsible for knowing the location of danger areas shown on Danger Area Charts published by the Civil Aeronautics Administration.

**d. Altitudes.** (1) A minimum flight altitude of 500 feet above the ground should be maintained at all times except during landings, take-offs, "dragging" of areas, and contour flying.

(2) When "dragging" areas, the pilot should select the flight path which will permit a safe forced landing in case of engine failure.

(3) Contour flying will be practiced only upon authority of the unit commander, in designated areas, and at designated times. Contour flying will habitually be done upwind.

**e. Charts.** Sectional charts of the area should be carried in each aircraft at all times. Before departing on extended flights, pilots should provide themselves with sectional charts covering the proposed route.

**f. Parachutes.** Parachutes should be worn during all flights in combat and during extended and acrobatic flights.

**43. GROUND REGULATIONS.** **a. Taxying.** (1) Pilots will execute a series of S-turns while taxying.

(2) Taxi pattern will be in a direction opposite to that of the air traffic pattern.

(3) Pilots will refrain from taxiing across the landing strip of the landing field. So far as possible, all taxiing will be done near the edges of the landing field.

**b. Clearing turns.** Before taking off, the pilot will habitually make a clearing turn in a direction opposite to that of the air traffic pattern.

**c. Tie-downs and chocks.** When not in use, aircraft must be tied down and chocks should be used to keep the aircraft from moving.

**d. Moving aircraft.** One man should be at each wing tip and at the tail when an aircraft is moved in proximity to other aircraft or obstructions.

**e. Starting.** Aircraft should be moved away from the parking line before engines are started. A fire extinguisher will be readily available outside the aircraft. All safety precautions will be observed, and during hand cranking the starting signals will be given by the individual at the propeller. An aircraft will not be started nor left running without a competent operator at the controls. Aircraft without self starters will be started according to the following procedure:

(1) The individual at the propeller calls out, "SWITCH OFF, GAS ON, THROTTLE CLOSED."

(2) The individual at the controls checks to insure that switch is off, gas is on, and throttle is closed or only slightly open and then calls out, "SWITCH OFF, GAS ON, THROTTLE CLOSED."

(3) The individual at the propeller rotates the propeller three or four times, and then calls out, "BRAKES ON, CONTACT."

(4) The individual at the controls applies brakes and repeats "BRAKES ON, CONTACT," and then turns the ignition switch on immediately.

(5) The individual at the propeller makes sure of his footing, faces the engine, and pulls the propeller through quickly with both hands, and backs away from the propeller quickly at each rotation until the engine is started.

f. **Warm up.** Aircraft should not be flown until the engine is warmed up in accordance with appropriate Army Air Forces Technical Orders.

g. **Propellers.** Except for the purpose of cranking, a propeller should not be touched for at least 15 minutes after engine operation.

h. **Refueling.** Aircraft should be electrically grounded while being refueled. (See fig. 7.)

**44. MISCELLANEOUS.** a. **Preflight inspection.** The pilot will perform the preflight inspection before the first flight of the day.

b. **Loading.** Except in extreme emergency the gross weight should not exceed the maximum specified by the Army Air Forces Technical Orders concerning the aircraft.

c. **Weather.** An aircraft should not be permitted to take off unless the weather is equal to or better than the minimum allowed by contact flight regulations.

d. **Flight plans.** Flight plans for extended flights will be filed in accordance with Army Air Forces

Regulation 15-23. Pilots will use the following procedure in filing flight plans:

(1) When an established Army Air Forces or naval aviation operations officer is available, the pilot will file and obtain approval of flight plan from the operations officer.

(2) Where no such military operations officer is available, the pilot will file a flight plan with an Army Air Forces flight control center. Civil Aeronautics Authority communication stations will transmit flight plans to the nearest Army Air Forces control center. Pilots must obtain approval and clearance from the Army Air Forces flight control center prior to departure.

(3) If no communication facilities are available, the pilot may take off and proceed to the nearest practicable location where communications are available, providing the flight can be made in accordance with contact flight rules. The pilot will file a flight plan and obtain approval and clearance, in accordance with instructions given above, before continuing flight.

**e. Smoking.** Smoking and open flames are prohibited within a radius of 50 feet of any aircraft, gasoline dump, fuel pump, fuel unit, and oil or dope storage dump or building. Smoking and open flares are also prohibited within 50 feet of any building or locality where dope is being brushed or sprayed.

**f. Sulfa drugs.** Personnel on flying status will not use any drugs of the sulfa group unless the use of such drugs has been specifically prescribed by a medical officer. Individuals who have taken any

sulfa drug internally will not fly for a period of 1 week after the last administration of such drug.

**g. Corrective lenses.** Pilots who have been instructed by flight surgeons to wear corrective lenses will wear these lenses while flying.

## CHAPTER 6

### HIGHER HEADQUARTERS LIGHT AVIATION

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**45. ORGANIZATION.** a. An air section is included in each of the following higher headquarters:

- Army Headquarters.
- Corps Headquarters.
- Corps Artillery Headquarters.
- Division Headquarters.
- Division Artillery Headquarters.
- Field Artillery Brigade Headquarters.
- Field Artillery Group Headquarters.
- Cavalry Group Headquarters (Headquarters, Armored Regiment, Light).

b. In general, this section consists of an air officer of field grade, pilots of company grade, airplane mechanics, two or three liaison aircraft, and two or three motor vehicles. The duties of the personnel are listed in paragraph 4.

**46. MISSION.** The mission of the air section in these higher headquarters is to assist the commander by carrying out the following functions:

a. Advising the commander on all matters pertaining to light aviation within the command.

- b. Coordinating with G-3 (S-3) and special staff sections the training, operation, and tactical employment of light aviation.
  - c. Coordinating with G-1 (S-1) and special staff sections personnel matters pertaining to light aviation by preparing plans for the relief, recuperation, transfer, and replacement of personnel.
  - d. Coordinating with G-4 (S-4) and special staff sections supply matters pertaining to light aviation by making arrangements for third and fourth echelon aircraft maintenance, procurement and distribution of Army Air Forces supplies, procurement and distribution of aircraft fuel and lubricants, establishing levels of Army Air Forces supply within the command, establishing a flow of replacement aircraft and supplies to units of the command, and coordinating the activities of the Air Forces Depot Units, Army, with the operation of light aviation within the command.
  - e. Maintaining liaison with air sections of subordinate units by making frequent visits and inspections.
  - f. Maintaining a situation map showing the location of major headquarters and their landing fields.
  - g. Maintaining rosters and statistics showing assignment of light aviation personnel in order to submit personnel status reports.
  - h. Maintaining rosters and statistics showing assignment of aircraft in order to submit aircraft status reports.
  - i. Preparing light aviation bulletins.
  - j. Maintaining records showing aircraft and personnel casualties and their causes.

k. Preparing and processing special light aviation reports.

**47. SPECIAL OPERATIONS.** a. The air section of each higher headquarters assists the commander during the planning phase of an operation in preparing plans for:

(1) Employing light aviation during all phases of the operation.

(2) Coordinating the loading, transporting, and delivery of subordinate unit air sections to the target area.

(3) Establishing levels of supply and flow of replacement aircraft, spare parts, and Army Air Forces supplies.

(4) Establishing a flow of replacement personnel.

(5) Coordinating the employment of light aviation with the ground forces, air forces, naval forces, and other services or allies.

(6) Coordinating communication between light aviation and ground, air, and naval forces.

b. Prior to the execution of special operations the air section assists the commander in controlling and maintaining communication with widely scattered elements of the command.

c. During the execution of special operations the air section assists the commander in making personal reconnaissances.

## CHAPTER 7

### LIGHT AVIATION WITH ARMORED UNITS

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**48. ORGANIZATION.** **a.** In armored units organic light aviation is provided for the following elements:

- Headquarters, Armored Division.
- Headquarters, Combat Command.
- Headquarters, Armored Division Artillery.
- Armored Field Artillery Battalion.
- Tank Battalion.
- Armored Reconnaissance Battalion.
- Cavalry Reconnaissance Group, Mechanized  
(Headquarters, Armored Regiment, Light).

**b.** An air section usually consists of two pilots, two mechanics, two aircraft, and associated equipment.

**49. MISSIONS.** The primary mission of light aircraft in armored units is command control. The particular type of mission that may be flown by the light aircraft of an armored unit depends in general upon the type of armored unit to which the aircraft are assigned. Each light aviation section must be trained so that it can accomplish any mission normally assigned to light aviation.

**a. Headquarters armored division.** The functions of the air section of the headquarters armored divi-

sion are to assist the division commander in controlling the division and to furnish a means for command liaison both within the division and with higher and adjacent commands.

**b. Headquarters combat command.** The air section of the combat command is primarily for use of the commander in controlling the combat command and for command liaison. Additional missions are:

(1) Reconnaissance.

(2) To aid in the control of high performance aircraft performing close support missions for the combat command.

(3) To supplement the aircraft of units in the command in case of emergency.

**c. Headquarters armored division artillery.** Missions assigned to the air section of an armored division artillery headquarters include providing the commander with the means for—

(1) Control of all organic and attached artillery.

(2) Command liaison.

(3) Supplementing the aircraft of any artillery battalion.

(4) Aerial photography.

**d. Armored artillery battalion.** The primary mission of the armored artillery battalion air section is the adjustment of artillery fire. Additional missions are:

(1) Continuous air surveillance of enemy forward areas.

(2) Route reconnaissance.

(3) Control of the firing batteries in forward displacement.

(4) Radio relay.

**e. Tank and armored reconnaissance battalions.** The primary mission of armored force light aircraft assigned to a tank or armored reconnaissance battalion is to assist the commander in control of the unit. Additional missions are:

- (1) Command liaison.
- (2) Continuous air surveillance of that part of the enemy front affecting the advance or security of that unit.
- (3) Reconnaissance.
- (4) Adjustment of artillery fire, or fire of its own elements when performing indirect fire missions.
- (5) Route reconnaissance.

**f. Reconnaissance units.** The principles of employment of light aviation with the Cavalry Reconnaissance Group, Mechanized (or the Armored Regiment, Light, if approved) are the same as those for light aviation with the combat command.

**50. TACTICAL EMPLOYMENT.** **a.** Armored unit air sections assigned to field artillery battalions are employed primarily for observation and adjustment of artillery fire.

**b.** Armored unit air sections assigned to other units, are primarily employed in control of the unit, command liaison, and to augment ground reconnaissance and security.

**c.** When an armored unit is in a stabilized situation, light aircraft should be employed to the maximum in aerial surveillance of the unit front. Control must be exercised that the minimum number of aircraft are over the front at one time. This

affords time for maintenance and training of the air sections.

d. When an armored unit attacks, the air section of that unit must maintain aerial surveillance on all sides of the command.

e. Armored unit light aircraft may be sent deep into enemy territory with a reconnaissance unit. In this case the reconnaissance unit must carry fuel and lubricants for the aircraft, select air strips, and protect the crew and aircraft if forced down.

f. Although battalion air sections are directly responsible to their battalion commanders, they frequently may be based at the combat command, or similar headquarters, landing field for the convenience of operation, supply, administration, local security, and maintenance. The technique of centralized operation is explained in detail in paragraph 23.

g. In stabilized situations, aircraft normally function under central control from the combat command, or similar headquarters, air strip. This method of operation, the most economical in personnel and matériel, facilitates continuous aerial surveillance of the unit's front and frees aircraft for special missions and necessary maintenance.

h. In fluid situations aircraft are released to battalion control.

**51. TRAINING.** a. **Individual Training.** (1) Armored unit light aircraft personnel should be trained in their various duties as outlined in this manual.

(2) Pilots must and mechanics should be graduates of the Army Ground Forces Air Training

School. In general, their training should be directed toward maintaining and improving their flying and mechanical proficiency.

(3) In units having air sections, all commanders and certain staff officers (Executive, S-2, and S-3) should receive specialized air observer training.

(4) Commanders, staff officers, reconnaissance officers, and reconnaissance elements must be trained to select air strips.

(5) All air section personnel must be thoroughly trained to operate and maintain air section communication equipment, vehicles, weapons, and air strips.

(6) Every effort must be made to develop teamwork between the air observer, pilot, and ground troops in order to obtain maximum combat efficiency. Ground units must be trained to furnish local security for air strips, and the nearest ground unit must automatically include the air strip in its local security plan. When an armored thrust continues after dark the air section must be moved close to a unit that will not move, or must be furnished security until it rejoins the unit the next day. During this type of operation it is the responsibility of the unit commander to see that some member of the attack force selects a new air strip, and sends its location to the senior pilot, so that the aircraft can join the column at first light.

(7) Commanders and staff officers must be trained to adjust artillery fire from light aircraft.

(8) Armored pilots are primarily Armored officers and secondarily pilots.

**b. Tactical Training.** (1) the air section should participate in unit training, unit field exercises, and

especially in field artillery service practices. All types and means of communication must be employed.

(2) The air section should be trained to operate its own landing field and to operate from a landing field under centralized control.

(3) Prior to an amphibious operation all armored unit light aviation personnel must receive extensive training using sandy beaches and the Brodie device.

(4) Chapter 3 covers the general features of tactical training applicable to all light aircraft air sections.

**52. COMMUNICATION.** a. A standard armored radio should be installed in each armored unit light aircraft. The unit command channel and the fire-direction channel of the direct support artillery battalion should be set on this radio. The command channel is for direct contact with the unit commander or control of a unit by its commander when he is in the air. The fire-direction channel is for the use of the direct support artillery battalion in adjusting artillery fire and as an alternate means of relaying messages.

b. A base set must be operated at each landing field to transmit air warning messages, and to maintain communication with the unit command post when wire communication fails or when the aircraft is out of range of the unit command post.

c. The unit communication officer should establish and maintain wire communication with the landing field whenever possible.

**d.** Pilots and observers must be expert voice radio operators. All personnel must be able to operate and maintain all communication equipment used by the air section.

## CHAPTER 8

### ENGINEER LIGHT AVIATION

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**53. ORGANIZATION.** An air section consists of one pilot, one mechanic, one airplane, and associated equipment organically assigned to each divisional engineer combat and armored battalion. In the nondivisional engineer combat battalion there are two mechanics. In addition to the organic personnel appropriate battalion staff officers and enlisted men are designated by the unit commander to act as observers.

**54. NORMAL MISSIONS.** The battalion air section is directly responsible to the battalion commander. Its normal missions include the following:

a. **Reconnaissance.** (1) *Specific.* Specific reconnaissance is used to obtain information required for planning, and for constructing or demolishing specific bridges, roads, railroads, airfields, stream crossings, mine fields, or other obstacles in friendly or enemy territory. Effectiveness of defense lines, barriers, and demolitions is also checked by specific reconnaissance. Information on disposition of both friendly and enemy troops is obtained.

(2) *Area search.* Area search is used when the specific location of reconnaissance objectives is unknown. Its purpose is to locate sources of engineer supplies, equipment, or material; sites for landing strips; displacements; water crossings; water

points; storage areas; road nets and lines of communications; newly laid enemy mine fields; recently prepared enemy obstacles and other indications of denial activity. Camouflage discipline must be constantly observed and reported upon in area searches.

b. **Aerial photography.** Aerial photographs are taken of specified objectives to aid in planning. (See fig. 19.)

c. **Security.** Work parties may be secured against surprise attack by the use of air observation.

d. **Liaison.** Liaison with other headquarters is maintained by the air section. When normal means of communication are not immediately available, urgent information is relayed to higher headquarters by the air section.

e. **Transportation.** The air section is used for emergency transportation of personnel.

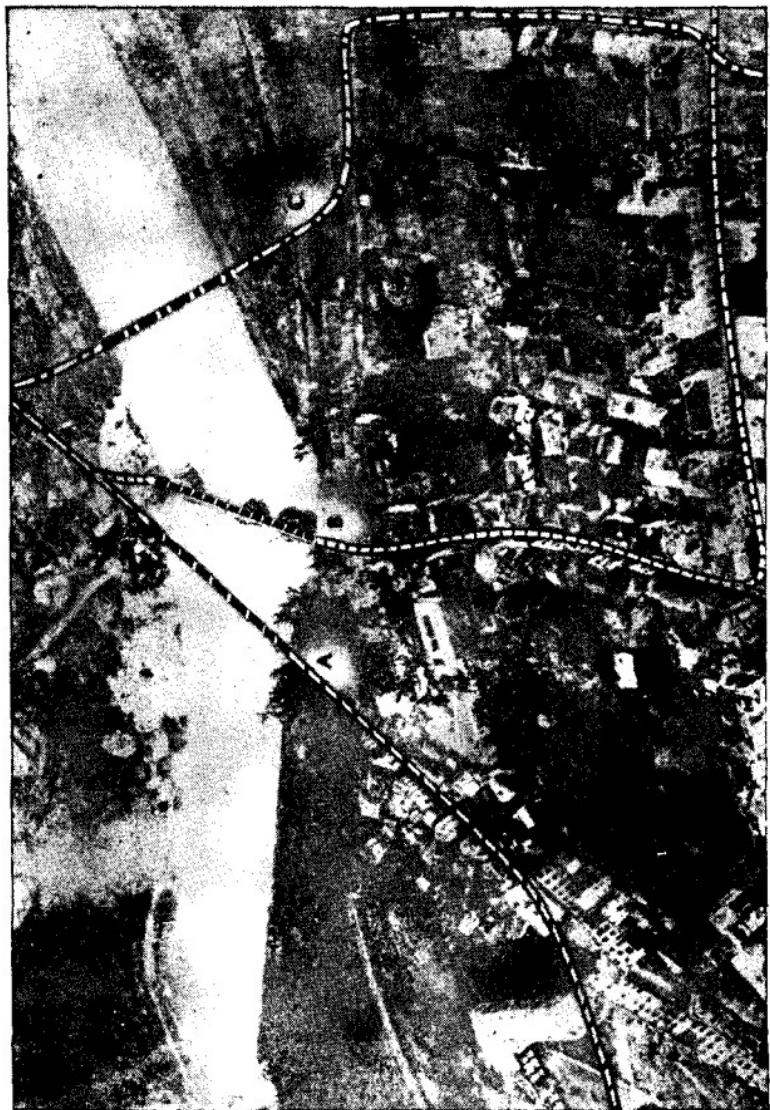
f. **March control.** During unit displacement or movement of equipment the air section aids in march control.

**55. SPECIAL MISSIONS.** a. Engineer aviation can be used to transport emergency supplies. Loading, limits, and methods of dropping are described in paragraph 31.

b. Emergency evacuation can be effected by the air section.

c. The engineer air section can be used to pick up and drop special messages. (See par. 14.)

**56. TRAINING.** Engineer air section personnel and unit observers must be trained in their various duties as outlined in chapters 2 and 3.



A. Possible site and approaches for a permanent type bridge.

B. Possible site and approaches for a panel type bridge.

C. Possible site and approaches for a treadway type bridge.

Figure 19. Air section photographs contain details required for efficient planning.

**a. Individual training.** (1) Pilots must and mechanics should be graduates of the Army Ground Forces Air Training School. Unit training should be directed generally toward maintaining and improving their flying or mechanical proficiency.

(2) Air observers are trained by the unit. The unit commander details suitable officers and enlisted men for training. The unit S-2 and S-3 furnish selected enlisted men for observer training from their respective sections. Those selected for training should have the following qualifications:

- (a) Weight less than 170 pounds.
- (b) Previous flying experience (desirable, but not essential).
- (c) Normal freedom from air sickness.
- (d) High proficiency in map reading.
- (e) Enthusiasm for such training and duty.
- (f) Capacity for intelligent observation.
- (g) Broad knowledge of military engineering.

(3) All air section personnel must be trained to operate and maintain air section communication equipment, vehicles, and weapons.

(4) All air section personnel and unit observers should be instructed in the use and operation of the K-20 camera, or other cameras used by the unit.

**b. Tactical training.** (1) The air section should participate in unit training and unit field exercises. Instruction must include operations on landing strips under unit control as well as operations under centralized control.

(2) Training for night missions is described in paragraphs 15 and 32.

(3) Chapter 3 covers the general features of tactical training for the air section and unit observers. In addition to subjects listed in chapter 3, the following must be included in the tactical training:

- (a) A thorough review of military map reading.
- (b) Measuring of short vertical and horizontal distances from the air by the use of gap calibrator (see app. IX) or similar device.
- (c) Preparation of engineer reconnaissance reports on the following:

1. Bridges and bridge sites.
2. Demolitions.
3. Roads and railways.
4. Local or enemy materials.
5. Road nets.
6. Water supply.
7. Defense lines, organization of ground.
8. Waterways.
9. Mine fields and obstacles.
10. Air strips and airfields.

(d) Use of appropriate forms (see app. X for sample forms) to facilitate reporting should be encouraged by the unit commander.

(e) Engineer pilots must be engineer officers as well as pilots. Similarly, engineer air section mechanics are primarily engineer enlisted specialists, not simply airplane mechanics. Since the engineer combat battalion is composed largely of specialists, air section personnel must receive additional training in related engineer duties.

**57. COMMUNICATION.** a. A suitable radio should be installed in aircraft of the engineer air

section for communication with the radio normal to engineer combat battalion headquarters as a base set.

b. The unit communication officer should establish and maintain wire communication with the landing strip or field, whenever possible.

c. Pilots and observers must be expert voice radio operators. Air section personnel must be able to operate and maintain all communication equipment used by the section.

## CHAPTER 9

### FIELD ARTILLERY LIGHT AVIATION

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**58. ORGANIZATION.** a. An artillery air section consisting of two pilots, two mechanics, two aircraft, and associated equipment is included in the Tables of Organization of every field artillery battalion, except the observation battalion.

b. An artillery air section consisting of an air officer of field grade, one air supply and engineering officer of battery grade (who is also a pilot), one pilot, one chief mechanic, two mechanics, two aircraft, and associated equipment is included in the Tables of Organization of every field artillery group, brigade, division artillery, and corps artillery headquarters.

**59. MISSION.** a. Each light aviation section must be trained so that it can accomplish any mission normally assigned to light aviation.

b. The missions of field artillery light aviation are the same as those listed in paragraph 2.

**60. TACTICAL EMPLOYMENT.** a. Although field artillery battalion air sections are directly responsible to their battalion commanders, they are frequently based at a division artillery or field artillery group landing field for convenience of operation, supply, administration, local security,

and maintenance. The technique of centralized operation is explained in detail in paragraph 23.

b. Centralized operation also permits the maintenance of a continuous aerial patrol by the aircraft of the field artillery battalions. The aerial patrol not only immobilizes the enemy in forward areas but also provides an extremely effective counterbattery measure by reducing enemy artillery activity.

c. In many situations registrations are more often conducted by field artillery air observers than by terrestrial observers. Air adjustments normally employ range-bracketing procedure modified for air observation as prescribed by FM 6-40. Field artillery pilots and observers must be thoroughly trained in adjusting fire of all calibers of field artillery weapons upon all types of targets.

d. A trained field artillery air observer should accompany the pilot on all combat missions. The combat effectiveness of a field artillery unit often depends upon the skill, efficiency, and training of its air observers. In combat the two officers best qualified and adapted to serve as air observers should be appointed as unit air observers as their primary duty.

e. Each field artillery unit commander must exercise every effort to effect maximum cooperation and coordination between the S-2, S-3, and the unit air section.

**61. TRAINING.** a. Individual training. (1) Field artillery air section personnel should be trained in their various duties as described in chapter 2.

(2) Pilots must and mechanics should be graduates of the Army Ground Forces Air Training School. In general, their training should be directed toward maintaining and improving their flying or mechanical proficiency.

(3) Air observers must be trained by the unit. The unit commander should detail certain officers to be trained as air observers in accordance with the provisions of paragraph 16.

(4) Every effort must be made to develop teamwork between the pilot, air observer, and fire-direction center in order to obtain maximum combat efficiency.

(5) All air section personnel must be trained to operate and maintain air section communications equipment, vehicles, and weapons.

b. **Tactical training.** (1) The air section should participate in unit training, unit field exercises, and especially in unit service practices.

(2) The air section should be trained to operate either from its own landing field or from a landing field under centralized control.

(3) Chapter 3 covers the general features of tactical training applicable to all artillery air sections.

**62. COMMUNICATION.** a. The standard field artillery fire control radio is installed in each field artillery aircraft. The unit fire-direction channel and a higher unit command channel are generally used for air-ground communication in adjusting artillery fire, reporting information, and relaying air warning messages.

- b. A base set must be operated at each landing field to transmit air warning messages and maintain communication with the unit command post when wire communication fails.
  - c. The unit communication officer should establish and maintain wire communication with the landing field whenever possible.
  - d. Pilots and observers must be expert voice radio operators. All personnel must be able to operate and maintain all communication equipment used by the air section.

**63. SPECIAL OPERATIONS.** a. Field artillery aircraft may be required to adjust naval gunfire. Pilots and observers should be trained in the procedure and technique of adjustment of naval gunfire.

b. Field artillery pilots and observers may sometimes accompany fighter-bomber pilots on air strikes (see par. 38) in order to adjust field artillery fire upon enemy antiaircraft positions and to immobilize targets by field artillery fire prior to attack by fighter-bomber aircraft.

c. Field artillery aviation may be extremely useful in performing night missions. Paragraphs 15 and 32 describe night flying training and procedure.

**64. MISCELLANEOUS.** a. Field artillery pilots are primarily field artillery officers and secondarily pilots.

b. Commanders should realize that while air section personnel, particularly the pilots, are necessarily specialists, they should be trained to perform other related field artillery duties.

## CHAPTER 10

### INFANTRY LIGHT AVIATION

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**65. ORGANIZATION.** An infantry air section consisting of one pilot, one mechanic, one aircraft, and associated equipment, is included in the Tables of Organization and Equipment, of the headquarters and headquarters company of each infantry regiment.

**66. MISSION.** Each light aviation section must be trained so that it can accomplish any mission normally assigned to light aviation. (See par. 2.)

**67. TACTICAL EMPLOYMENT.** **a.** Although infantry air sections are directly responsible to their respective commanders, they are frequently based at division landing fields for convenience of operation, supply, administration, local security, and maintenance. The technique of centralized operation is explained in detail in paragraph 23.

**b.** Every effort will be made to locate a landing strip near the regimental command post so as to facilitate briefing by the S-2 or S-3, and interrogation upon return of the pilot from his mission.

**c.** A trained observer will habitually accompany the pilot on his missions. Occasionally this duty may be performed by a member of the staff or the commander. At times the pilot will be accompanied

by a patrol leader so that the patrol leader may see the route his patrol is to follow. Commanders and staff officers of all echelons should be encouraged to take maximum advantage of every opportunity to use light aviation for personal reconnaissance.

d. Each infantry commander must exercise every effort to effect the maximum cooperation and co-ordination between the intelligence and operations sections of his staff, and his air section.

**68. TRAINING.** a. Individual training. (1) Infantry air section personnel should be trained in their various duties as shown in chapter 2.

(2) Pilots must be graduates of the Army Ground Forces Air Training School and, in addition to the training received there, they should be thoroughly trained in infantry tactics and operations to include:

(a) Organization and equipment of the infantry regiment.

(b) Infantry tactics.

(c) Combat intelligence.

(d) Map and air photo reading and interpretation.

(e) Radio communication procedure, maintenance, and operation.

(3) Mechanics should be graduates of the Air Mechanic Course at the Army Ground Forces Air Training School.

(4) Air observers must be trained by the unit. The regimental commander should detail certain officers to be trained as air observers in accordance with the provisions contained in paragraph 16.

(5) All air section personnel must be trained to operate and maintain air section communication equipment, vehicles, and weapons.

b. **Tactical training.** (1) The air section should participate in unit training, unit field exercises, and the adjustment of infantry fires.

(2) It should be trained to operate its own landing field and to operate from a centralized landing field.

(3) Chapter 3 covers the general features of tactical training applicable to all infantry air sections.

**69. COMMUNICATION.** a. As soon as possible after a landing field is put in operation, radio and wire communication is established in order to facilitate the transmission of instructions and reports.

b. An infantry type radio set is installed in the aircraft. It usually works with radios at the regimental command post and at the landing field. By changing channels it may communicate with other radio nets in the regiment if necessary, in order to accomplish any of the missions listed in paragraph 75. The pilot and observers must be expert voice radio operators.

c. Urgent messages such as air warnings may be transmitted by any set in the regiment by tuning to the aircraft radio channel.

**70. SPECIAL OPERATIONS.** a. Infantry aircraft may be employed to adjust artillery fire. Pilots and observers should be trained in the procedure and technique of artillery fire adjustment.

b. Infantry aircraft may be employed in performing night missions. Paragraphs 15 and 32 describe night flying training and procedure.

**71. MISCELLANEOUS.** a. Infantry pilots are primarily infantry officers and secondarily pilots.

b. Commanders must realize that air section personnel are necessarily specialists, but should make every effort to train them, particularly the pilots, in other related infantry duties.

## CHAPTER 11

### SIGNAL LIGHT AVIATION

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**72. ORGANIZATION.** An air section consisting of two pilots, two mechanics, two airplanes, and associated equipment is organically assigned to the Field Operation Company of the Signal Battalion, T/O&E 11-18, 15 February 1946.

**73. MISSIONS.** The air section is directly responsible to the unit commander. Its missions include the following:

a. The primary mission of signal light aviation is to provide air messenger service which will normally be established between major units for the delivery and pick-up of messages which need not or cannot be transmitted by other means. This service is in addition to other facilities and runs concurrently, weather permitting, on a scheduled basis.

b. The secondary mission of signal light aviation is to provide service for the delivery and pick-up by officer courier (other than pilot or signal officer) of very highly classified and priority documents, which cannot be transmitted by other means.

c. Other missions, such as aerial photography, reconnaissance for command posts and line routes, and camouflage discipline may be flown by signal aircraft. However, they should not interfere with

the primary and secondary missions of the air section or unit.

**74. TRAINING.** Signal light aviation personnel should be trained in their various duties as described in chapter 2.

**a. Individual Training.** (1) Pilots must and mechanics should be graduates of the Army Ground Forces Air Training School. In general, their training should be directed toward maintaining and improving their flying or mechanical proficiency.

(2) All air section personnel must be trained to operate and maintain air section communication equipment, vehicles, and weapons.

**b. Tactical Training.** (1) The air section should participate in unit training and combined field exercises whenever possible. During these exercises, traffic loads should be placed on messenger and courier services. Additional missions as mentioned in paragraph 73c may be requested by units participating in the exercises.

(2) The air section should be trained to operate either from its own landing field or from a landing field under centralized control.

**75. COMMUNICATION.** **a.** A standard radio installed in aircraft employed by Signal units should be capable of communicating with air strips and landing fields, signal centers of division and higher headquarters, ground troops, other Army Ground Forces light aircraft, and Army Air Forces liaison aircraft.

**b.** Wire communication should be established and maintained between the landing field or air strip

and signal centers being served by signal light aircraft.

c. Pilots must be fully qualified voice radio operators and air section personnel must be able to operate and maintain all communication equipment used by signal light aviation.

## APPENDIX I

### ARMY AIR FORCES LIGHT AVIATION PROVIDED FOR USE OF ARMY GROUND FORCES UNITS

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**1. GENERAL.** Army Air Forces light aviation is organized into conventional Army Air Forces type units, that is, squadrons, flights, etc., in contrast to the Ground Forces type of organization wherein individual aircraft or pairs of aircraft, with a minimum number of operating personnel, are assigned directly to Army Ground Forces units as an actual part of those organizations. In general, Army Ground Forces organic aircraft perform the majority of missions required by echelons from divisions down. Army Air Forces light aviation units supplement organic Army Ground Forces aircraft, performing the same type missions for corps and higher echelons. Aircraft from Army Air Forces units are available to any ground unit upon request through normal command channels. Due to their centralized organization it is practicable for Army Air Forces units to operate efficiently with somewhat heavier and more complicated equipment than is feasible under a decentralized system of assignment.

**2. MISSION. a.** Corps and higher ground echelons normally call on Army Air Forces light aviation

units to perform missions. Commanders of lower echelons should request Army Air Forces light aviation, when the—

(1) Mission requires a sustained effort, for which a centrally organized unit is held to be more suitable.

(2) Number of aircraft required to perform the mission is greater than availability of organic aircraft.

(3) Aircraft or equipment of Army Air Forces units is more suitable for performance of the required mission than that of organic air sections, or when the particular technique required to perform the mission is one for which an Army Air Forces unit is specially trained.

b. Conditions outlined above assume that sufficient time is available for the request to be made and fulfilled. This length of time will vary with different conditions and organizations. Under urgent conditions it may be necessary for organic aircraft to perform missions for which Army Air Forces units are more suitable. Under ordinary circumstances maximum use should be made of the Army Air Forces aviation provided.

**3. ARMY AIR FORCES LIAISON SQUADRON (T/O&E 1-977).** a. **Basis of Assignment.** Normally attached one per army, and one per theater or task force headquarters. Additional squadrons may be assigned to Army Air Forces in the locality as required. When a squadron is attached to an army, the army headquarters normally retains the squadron headquarters and one flight, and attaches one flight to each of its corps headquarters.

**b. Characteristics and Capabilities.** (1) The Army Air Forces liaison squadron is normally composed of four flights of eight liaison type aircraft each. The squadron has command and administrative sections, and the communications, engineering, mess, photographic, supply, transportation, and medical sections necessary to enable it to operate as an independent unit in the performance of its mission. It may have more than four liaison flights, or it may have one or more utility cargo or helicopter flights, if required.

(2) The liaison pilot of Army Air Forces is an enlisted man, normally a noncommissioned officer of one of the first three grades. He is trained to fly his assigned aircraft in the performance of all the type missions usually grouped under the general term "liaison," that is, courier, light transport, visual and light photo reconnaissance, column control, camouflage inspection, limited aerial supply, and air evacuation of casualties. In performing reconnaissance, column control, and camouflage inspection flight missions, it is ordinarily required that an officer observer fly with the liaison pilot. Two trained officer observers are provided in the liaison squadron for this purpose, or appropriate Army Ground Forces officers may be utilized.

(3) The organization, equipment, and type personnel of the liaison squadron make it particularly suitable for personnel and cargo transport, aerial supply, and air evacuation missions. The aircraft have greater load-carrying capacity than the smaller organic liaison aircraft; the pilots are capable of performing such missions without assistance from officer crew members; and the organization of the

squadron facilitates its use, in whole or in part, for a sustained effort of the scale required. Additional squadrons may be requested from the Army Air Forces for important missions where a large scale or long term effort is required.

## **APPENDIX II**

### **CHECK SHEET FOR INSPECTION OF UNIT AIR SECTION**

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#### **Section I. TRAINING**

1. Are training directives, programs, and orders adequate?
2. Is training continuous, and directed at the elimination of bad flying habits as well as the improvement of flying technique, aircraft and vehicle maintenance, and the technique of air observation?
3. Is adequate communication training being conducted?
4. a. Does flight training include practice in take-offs and landings—
  - (1) On roads?
  - (2) Between panels?
  - (3) Over simulated barriers?b. Does flight training include training in evasive maneuvers?
5. Do pilots make two or more extended cross-country flights per month?
6. Is observer training for pilots and observers being conducted?

7. Are air mechanics, observers, and other designated personnel being trained in—
  - a. The selection and preparation of roads and fields suitable for use as landing strips?
  - b. The concealment and camouflage of the aircraft and matériel?
  - c. Ground handling of aircraft?
8. Are pilots and observers sufficiently proficient in reading maps and aerial photographs to locate—
  - a. Suitable areas for landing fields?
  - b. Routes of access and supply to landing fields?
  - c. Best possible flight paths for flying missions?
9. Are satisfactory ground schools organized and conducted for pilots in these subjects—
  - a. Navigation?
  - b. Meteorology?
  - c. Air traffic rules?
  - d. Aircraft clearances?
  - e. Pilot's Information File and appropriate Army Air Forces Technical Orders, forms, and records?
10. Do air section personnel go out frequently on tactical exercises for practical experience in—
  - a. Field reconnaissance for selection and organization of landing strips?
  - b. Display of panels?
  - c. Short-field flying technique?
  - d. Cooperation with the unit on field maneuvers?
11. Are all air section personnel being trained in the use of small arms and the caliber .50 machine gun?

12. Is the air section included in field problems conducted for unit training?
13. Is training for tactical employment conducted in accordance with this manual?
14. Are aircraft which are on the ground during tactical operations habitually camouflaged or concealed?
15. Are air warning systems established and operated during field exercises?
16. Are all extended cross-country flights authorized by the appropriate commander and covered by proper orders?
17. Is training in night flying being conducted safely and properly?

## **Section II. ADMINISTRATION AND RECORDS**

18. Are the following publications on hand and available for reference—
  - a. Applicable War Department Field Manuals and Training Circulars?
  - b. Applicable directives issued by higher headquarters?
  - c. Appropriate Army Regulations, including AR 95-120?
  - d. Appropriate Army Air Forces publications, including Pilot's Information File and Army Air Forces Technical Orders and Regulations?

19. Have safety regulations and air traffic regulations been prescribed and enforced?
20. Are all pilots familiar with local restricted and danger areas?
21. Are sectional aeronautical charts available in sufficient quantity for extended flights?
22. Has the air officer procured and distributed copies of Airman's Guide, Danger Area Charts, Directories of Airfields, and Radio Facility Charts?
23. Are new pilots required to familiarize themselves with local conditions of terrain and weather before attempting tactical or extended flights?
24. Is a record of aircraft accidents and damages adequately maintained?
25. Is a satisfactory record of missions maintained?
26. Are proper precautions prescribed and observed concerning mooring, starting, refueling, and ground handling of aircraft?
27. Are personnel not in possession of a pilot rating or not on flying status permitted to fly the aircraft as pilot or co-pilot?
28. Have all pilots passed a physical examination for flying during January or February of the current year?

29. Are spare parts, tools, and aircraft supplies properly handled and stored?
30. Are requisitions for aircraft supplies and spare parts prepared and forwarded through the prescribed channels?
31. Are the following Army Air Forces forms maintained properly—
- a. Form 1, Flight Report—Operations?
  - b. Form 1A, Flight Report—Engineering?
  - c. Form 5, Individual Flight Record?
  - d. Form 41B, Maintenance Inspection Report?
  - e. Form 46, Parachute Log Record?
  - f. Form 60A, Technical Instruction Compliance Record (Aircraft)?
  - g. Form 60B, Technical Instruction Compliance Record (Engines)?
  - h. Form 61, Propeller, Historical Record?
  - i. Form 263, Aircraft Checker's Report?
32. Are aircraft daily and preflight inspections made properly? Are aircraft periodic inspections made at proper times (25 hours, 50 hours, 100 hours, etc.)?
33. Are proper grades of aircraft engine oil and aviation gasoline being used?
34. Are aircraft clean and free of accumulated oil and dirt? Are windshields and windows clear?
35. Is gasoline strained through a chamois? Are aircraft grounded properly when being refueled?

- 36.** Are compasses adjusted periodically as required by Army Air Forces Technical Order 05-15-2?
- 37.** Are parachutes inspected once every 10 days as directed by Army Air Forces Technical Order 13-5-2? Are parachutes repacked by an authorized parachute rigger at least once every 60 days?
- 38.** Are parachutes clean, handled properly, and stored in a clean dry place?
- 39.** Are aircraft fire extinguishers filled to capacity and in good condition?
- 40.** Is one master set of applicable Aircraft Maintenance Inspection Forms available for each type of aircraft?
- 41.** Are all airplane and engine mechanics (747) graduates of the Army Ground Forces Air Mechanic Course of the Army Ground Forces Air Training School?
- 42.** Are all pilots graduates of the Army Ground Forces Pilot Course of the Army Ground Forces Air Training School?

## APPENDIX III

### FLIGHT MANEUVERS

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#### Section I. BASIC FLIGHT MANEUVERS

- 1. TAKE-OFFS AND LANDINGS.** Normal take-offs, power-off landings, power-off spot landings from 90° and 180° approaches. Emphasis on control, coordination, and accuracy of landings.
- 2. COORDINATION EXERCISES.** Rolling from bank to bank with a 90° change of direction, and rolling from bank to bank with nose held on a reference point on the horizon. Executed above 500 feet.
- 3. LEVEL TURNS.** Precision turns at varying degrees of bank and change of direction. Careful attention to coordinated entry and recovery, and constant altitude and bank. Executed above 1,500 feet.
- 4. S-TURNS.** Executed cross-wind across a road or other reference line. Emphasis on constant ground pattern and proper correction for drift. Executed at 500 feet.
- 5. RECTANGULAR PATTERN.** Executed at 500 feet above a pattern on the ground. Emphasis on

true rectangular pattern and proper correction for drift.

**6. EIGHTS AROUND PYLONS.** Executed at 500 feet with emphasis on constant altitude, ground pattern, and corrections for drift.

**7. CLIMBING AND DIVING TURNS.** 720° power-turns and maximum performance climbs completed above 1,500 feet.

**8. SLIPS.** Not practiced with flaps down.

**9. TWO-TURN POWER-OFF SPINS.** Completed above 1,500 feet. Executed to the right and left, with emphasis on stopping on a selected point and recovering without gaining excessive speed. Spins must not be executed in aircraft which are placarded against spinning.

## **Section II. SPECIAL FLIGHT MANEUVERS**

**10. TAKE-OFFS AND LANDINGS TO PANELS.** Panels mark the usable limits of the landing strip. Power stall approaches and efficiency take-offs are made in order to attain proficiency in using minimum landing and take-off space.

**11. TAKE-OFFS AND LANDINGS OVER BARRIERS.** Landings and take-offs over simulated barriers should be practiced extensively to develop technique in using fields with actual barriers and in estimating take-offs and landing distances.

## **12. TAKE-OFFS AND LANDINGS ON ROADS.**

Take-offs and landings on roads using both three-point and wheel landings should be practiced frequently.

## **13. CROSS-WIND LANDINGS AND TAKE-OFFS.**

Both "crab" and "slip" methods of cross-wind landings and take-offs should be practiced with exercises outlined in paragraphs 10, 11, and 12 above.

## **14. ONE-WHEEL LANDINGS AND TAKE-OFFS.**

One-wheel landings and take-offs should be practiced on curved roads.

## **15. CONTOUR FLYING.**

Contour flying should be done at altitudes from 10 to 20 feet above the general level of trees and obstructions. For reasons of safety, aircraft should not be flown below the level of trees, wire lines, and other obstructions.

## **16. LANDINGS FROM CONTOUR APPROACHES.**

Upwind approaches  $\frac{1}{2}$  mile from the field, at an altitude of about 50 feet, with emphasis on proper timing in closing the throttle to effect the landing and stopping of the aircraft between two panels, should be practiced in conjunction with contour flying.

## **17. EVASIVE MANEUVERS.**

Diving and turning to low altitudes and contour flying back to the field, making use of broken ground patterns, tree lines, and creek lines, should be practiced frequently.

## APPENDIX IV

### THE BRODIE DEVICE

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- 1. GENERAL.** The Brodie device consists of a cable, suspended parallel to and about 65 feet above the ground or water, which will support a liaison aircraft during landings and take-offs. The Brodie device has been developed and is available for installation on land or on a ship. It has been found extremely valuable in amphibious operations mounted on an LST. With training and practice, Army Ground Forces pilots can operate their aircraft from the device with comparative safety.
- 2. LAND RIG. a. Description and operation.** The main landing cable is 500 feet long and is suspended over the ground by means of four vertical poles 65 feet high. Two poles, 160 feet apart, are located at each end of the main cable and support it by a bridle arrangement as shown in figure 20. In landing and taking off, the aircraft is flown into the wind between the pair of poles at either end. A hook is mounted above the cabin of the aircraft. (See fig. 21.) As the aircraft comes in under the cable for a landing, this hook engages a loop suspended from a trolley which runs along the cable. Included in the installation is a braking device for slowing the aircraft down after a landing has been effected. A system for lowering the airplane to the ground after landing, and raising it

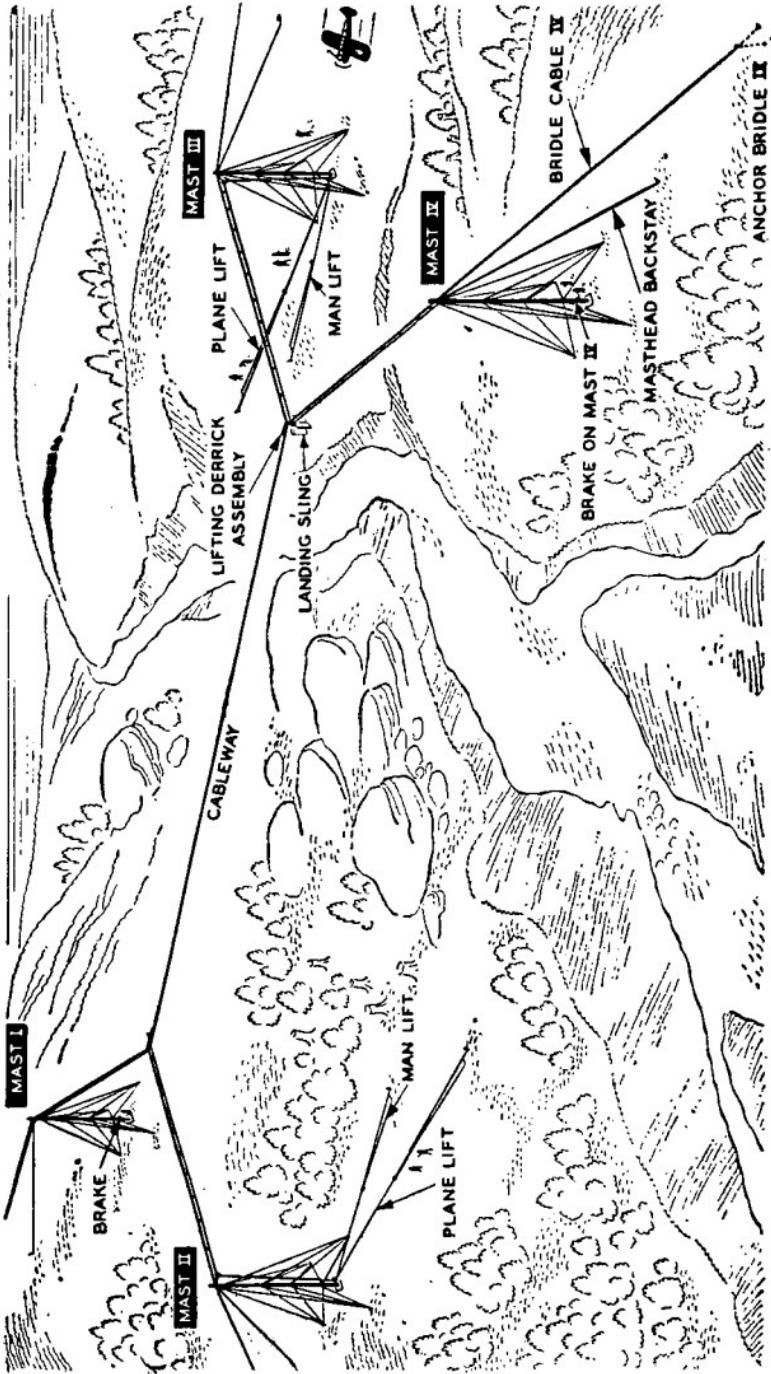
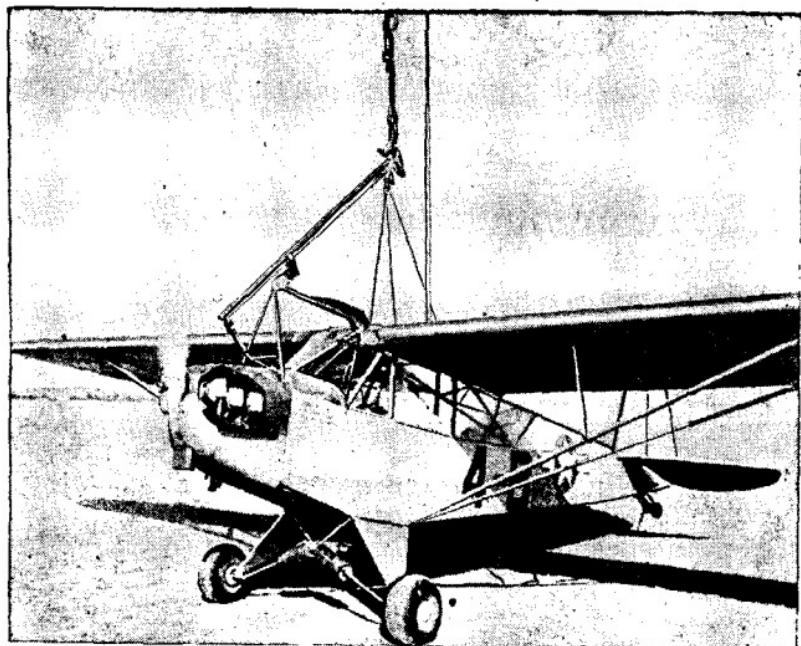


Figure 20. Land installation of the Brodie device.



*Figure 21. L-4 aircraft equipped with hook for operating from the Brodie device.*

back to the cable for take-off is an integral part of the equipment. In taking off, the pilot can disengage the hook when the aircraft has attained flying speed.

**b. Time and equipment required for erection.** From 250 to 350 man hours are required to erect the Brodie device land rig under favorable conditions. In extremely difficult terrain considerably more time and work may be required. The equipment used is prefabricated and can be transported in two 2½-ton trucks.

**c. Employment.** The land rig is useful for training pilots in the use of the Brodie device and may be employed in the event that extremely

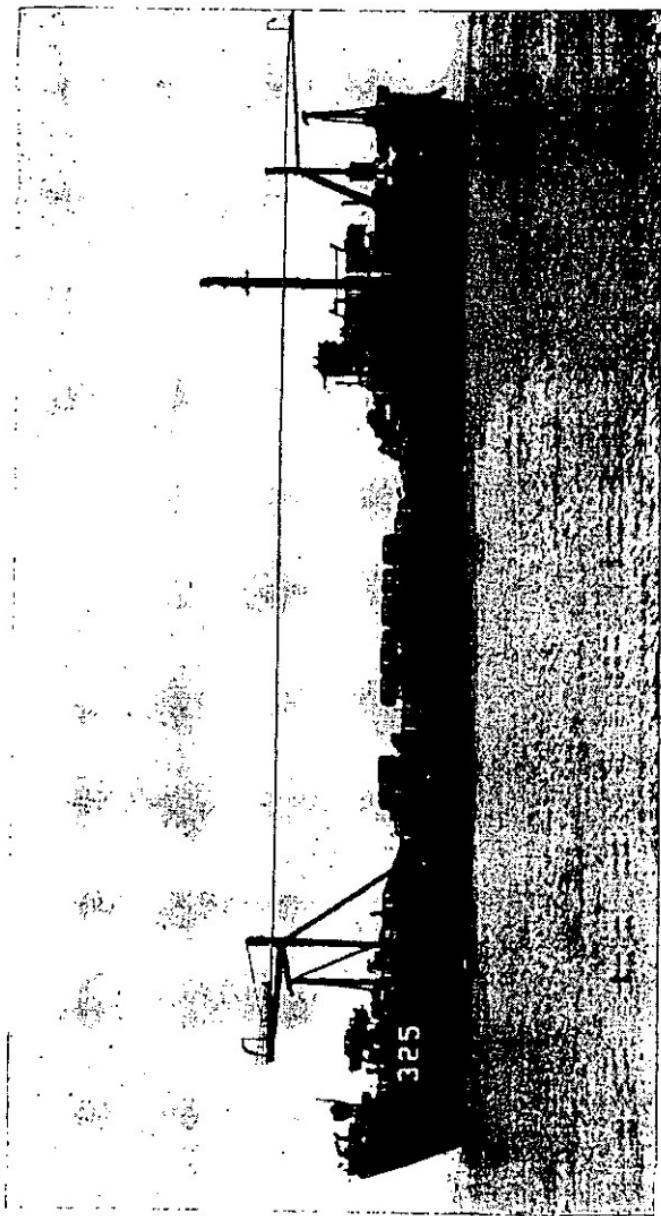


Figure 22. Installation of the Brodie device on a landing ship, tank (LST).

rugged or swampy terrain is encountered which would prohibit the use of a normal landing strip.

**3. LANDING SHIP RIG.** **a. Installation and operation.** In the installation of the Brodie rig on a ship, the cable is suspended over the side of the ship between booms mounted on the bow and stern. (See figs. 22 and 23.) All other features of installation and operation are the same as the land rig.

**b. Employment.** The chief use of the Brodie installation on a ship is as a landing device for the liaison aircraft during amphibious operations. LST's having the rig incorporated into their design are now available.



*Figure 23. L-4 aircraft engaging the hook of a Brodie device on a landing ship, tank (LST).*

## APPENDIX V

### TARGET SPOTTING RANGE

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- 1. PURPOSE.** A target spotting range is very useful in training pilots and air observers to locate targets of opportunity and to plot accurately these targets on a gridded map or aerial photograph. To be effective the range should simulate combat conditions as nearly as possible.
- 2. DESCRIPTION.** Any large area of terrain of which a suitable map or aerial photograph is available can be used as a target spotting range. A sector of observation should be assigned to the pilot and observer. Preferably the area chosen is one which will have simulated front lines and a certain amount of activity, such as moving vehicles, personnel, and equipment, which the observer can plot as enemy or friendly activity on his map or photograph. Normally the observer will be held responsible for reporting all activity in a sector from four to five thousand yards wide extending from the front lines back into "enemy" territory to the limit of his observation.
- 3. SIMULATED GUN FLASHES.** The value of the target spotting range is greatly enhanced if simulated gun flashes are set off at intervals at

points on the range which would be logical locations of enemy gun positions.

**4. EMPLOYMENT.** Each observer should go aloft for a period of target spotting equipped with a map of the target area, a pencil, and notebook. The spotting period should generally last not longer than an hour, during which time the observer records the location by coordinates, the time, and the nature of all activity which takes place in his sector. Several aircraft can be in the air during each observation period. Additional training may be given by having the observer conduct on the radio simulated fire missions on targets of opportunity. This procedure develops speed in evaluating and adjusting fire upon targets of opportunity..

## APPENDIX VI

### PUFF TARGET RANGE

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- 1. MISSIONS.** Missions are flown in a manner simulating combat conditions. The flight path of the aircraft should be from 4,000 to 6,000 yards from the target area. Radio communications should be established.
- 2. TARGET AREA.** The target area should be approximately 900 yards wide and 800 yards deep. The terrain should be rolling but a  $\frac{1}{4}$ -ton truck must be able to drive over it rapidly. A diagram of the target area is shown in figure 24. The base point is a large white panel installed at one end of the range. The target consists of a second large white panel mounted on a  $2\frac{1}{2}$ -ton truck. The location of the target truck is changed for each problem
- 3. GUN POSITION.** The gun position is assumed, and indicated on a map or aerial photograph, a copy of which is furnished to each pilot and observer. The gun position should be located 4,000 to 6,000 yards from the target area and should be changed frequently
- 4. BURST.** The burst is produced by exploding a home-made lime bomb. The bomb is made by plac-

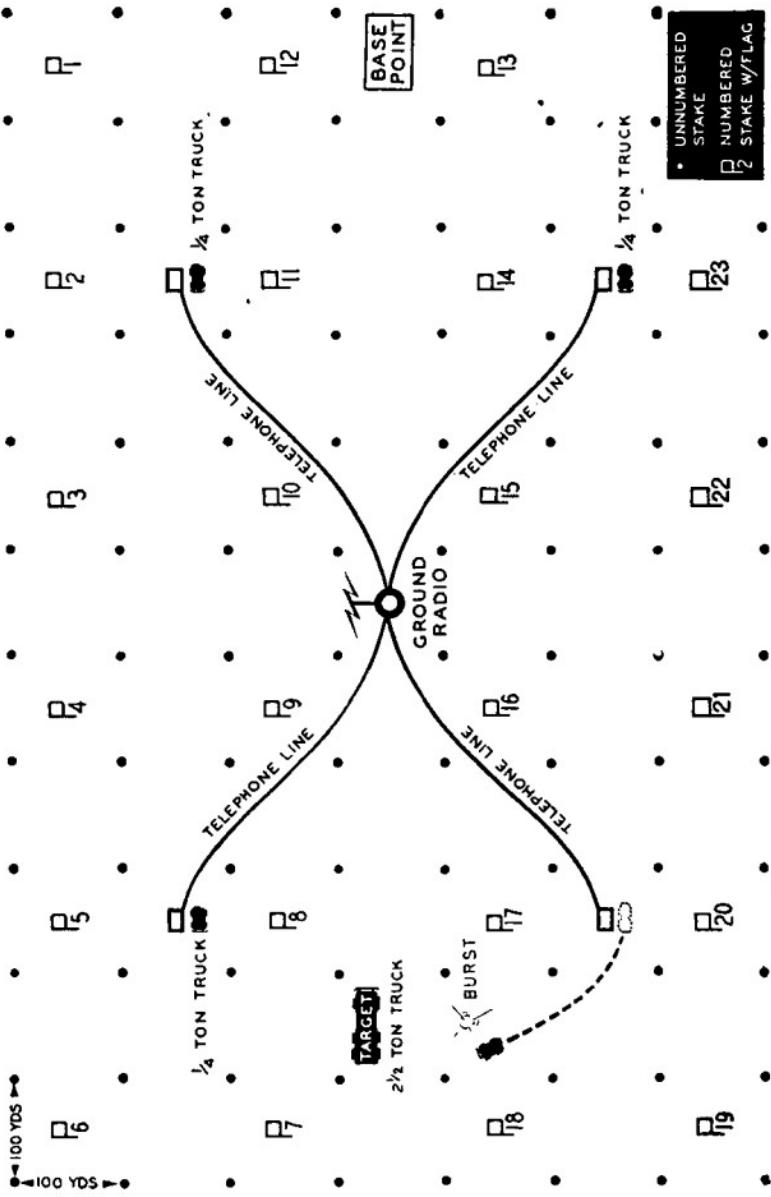


Figure 24. Puff target range.

ing a small amount of lime, a detonator cap, and a short length of fuze in a paper sack. The upper portion of the sack is rolled around the lower portion containing the lime. The complete bomb is about 3 inches in diameter and 8 inches long, with the fuze projecting from one end.

**5. COMMUNICATION.** The radio installed in the aircraft works with a similar radio located near the center of the target area. The location of this ground radio set is called the control center, and simulates a fire-direction center.

**6. OPERATION.** Four  $\frac{1}{4}$ -ton trucks, each equipped with a supply of lime bombs, are required. One of these  $\frac{1}{4}$ -ton trucks is placed near each corner of the impact area. Four telephone lines must be laid, one to the location of each of the  $\frac{1}{4}$ -ton trucks. The correction from the observer is received at the ground radio set and is plotted on a control board. The "coordinates" of the position of the next burst are then telephoned to the  $\frac{1}{4}$ -ton trucks; the truck nearest to the point where the "round" should hit drives to the point designated and explodes a lime bomb. The observer corrects this burst and the procedure is repeated.

## APPENDIX VII

### ARMY AIR FORCES FORMS AND RECORDS

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1. The following list of Army Air Forces forms and records has been compiled for use as a ready reference for Army Ground Forces light aviation personnel.
2. Instruction in the preparation of those forms and records which are most frequently used is included in the course of instruction given by Army Ground Forces Air Training School.
3. A complete index of Army Air Forces blank forms is contained in Army Air Forces Regulation No. 15-0.

#### TRAINING AND OPERATIONS

<i>No.</i>	<i>Date of issue</i>	<i>Title</i>	<i>Reference</i>
1	1-1-44	Airplane Flight Report —Operation.	AAF Reg 15-1.
1A	1-1-44	Airplane Flight Report —Engineering.	AAF Reg 15-1.
5	12-7-42	Individual Flight Rec- ord.	AAF Reg 15-5.
7	5-9-41	Flying Evaluation Re- port.	AAF Reg 35-16.
8	10-1-43	Instrument Pilot Cer- tificate (White).	AAF Reg 50-3.
8A	10-1-43	Instrument Pilot Cer- tificate (Green).	AAF Reg 50-3.

<i>Form No.</i>	<i>Date of issue</i>	<i>Title</i>	<i>Reference</i>
8B	10-1-43	Pilot Instrument Certificate Application and Flight Check Form.	AAF Reg 50-3.
14	10-1-44	Report of Major Accidents.	AAF Reg 62-14 and AR 95-120.
14A	9-1-44	Report of Minor Accidents.	AAF Reg 62-14 and AR 95-120.
15	11-1-44	Invoice.	AAF Reg 15-15.
15A	1-1-44	Invoice Envelope (Formerly AAF Form 9, Flight Envelope).	AAF Reg 15-15.
17	6-15-44	Damage to Property Certificate.	On form and AR 95-120.
21A	9-15-42	Navigator's Log (Small Form).	AAF Reg 15-21 and 15-21A.
23	8-15-43	Aircraft Clearance.	AAF Reg 15-23.
24	4-1-43	Pilots' Information File —Table of Contents.	AAF Reg 15-24.
24A	2-28-44	Pilots' Information File —Temporary Record of Compliance.	AAF Reg 15-24.
28	12-15-43	Army Air Forces Physical Fitness Test Report.	AAF Reg 50-10 and 50-14.
28A	11-1-43	Army Air Forces Physical Fitness Test and Record Card.	AAF Reg 50-10 and 50-14.
38A	5-1-44	Inventory of Equipment.	AAF Reg 15-38.
39	4-13-44	Aircraft Accident Log.	AAF Reg 62-19.

### MAINTENANCE AND INSPECTION

41B	5-1-44	Maintenance Inspection Record (Book Form).	AAF Reg 15-41.
46	5-1-43	Parachute Log Record.	AAF Reg 15-46.
48	4-25-42	Work Order.	AAF Reg 15-48.
49	9-1-42	Serviceable Part Tag (Yellow).	AAF Reg 15-50.

<i>Form No.</i>	<i>Date of issue</i>	<i>Title</i>	<i>Reference</i>
49A	1-1-45	Serviceable Part Tag (Yellow Label).	AAF Reg 15-50.
50	12-1-43	Repairable Part Tag (Green).	AAF Reg 15-50.
51	9-1-42	Condemned Part Tag (Red).	AAF Reg 15-50.
54	2-18-43	Unsatisfactory Report.	AAF Reg 15-54.
56	11-1-43	Maintenance Inspection Record.	AAF Reg 15-56.
57	6-15-42	Pilot's Compass Correction Card.	TO 05-15-2.
60A	5-1-44	Technical Instruction Compliance Record (Aircraft).	AAF Reg 15-60 and TO 00-20A.
60B	5-1-44	Technical Instruction Compliance Record (Engines).	AAF Reg 15-60 and TO 00-20A.
61	5-1-44	Propeller Historical Re-Record.	AAF Reg 15-61 and TO 00-20A.

### SUPPLY

81	4-15-43	Stores Charge.	AAF Reg 15-81.
82	4-15-43	Stores Credit (Yellow).	AAF Reg 15-82.
83	9-1-42	Identification Tag (White).	AAF Reg 15-50.
83A	9-1-42	Identification Tag UR (White).	AAF Reg 15-50.
102	5-14-42	Requisition.	AAF Reg 15-102.
104A	7-28-37	Shipping Ticket.	AAF Reg 15-104.
104B	12-1-44	Supplementary Requisition and Shipping Ticket (Domestic).	AAF Reg 15-104.
104C	5-15-44	Supplementary Requisition and Shipping Ticket (Domestic).	AAF Reg 15-104.
110A	9-1-44	Daily Aircraft Status and Flying Time Report.	AAF Reg 15-110.

<i>Form No.</i>	<i>Date of issue</i>	<i>Title</i>	<i>Reference</i>
110B	9-1-44	Monthly Aircraft Status, Flying Time, and Serial Number Inventory Report.	AAF Reg 15-110.
121	10-1-44	Individual AAF Issue Record.	AAF Reg 15-121.
122	1-1-44	Report of Disabling Injury (Military and Civilian).	AAF Reg 15-122.
123	9-1-44	Officer's Evaluation Report.	AAF Ltr 35-140.
244	12-11-44	Aircraft Delivery Receipt and Paper Work List.	AAF Reg 15-244.
263	4-15-43	Aircraft Checkers Report.	AAF Reg 15-263.

#### MEDICAL

205	5-15-44	Medical Officer's Report of Aircraft Accident.	AAF Reg 15-205 and on form.
206	9-14-44	Air Crew Member Physical Record Card.	AAF Reg 15-206.

## APPENDIX VIII

### INSTALLATION OF SCR-619 IN L-4 AND L-5 AIRCRAFT

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**1. INSTALLATION OF SCR-649 IN L-4 AIRCRAFT.** a. The SCR-619 radio is installed on the rear deck of the L-4 aircraft aft of the observer as shown in figures 25 and 26.

b. The following procedure is used:

(1) Remove the pack board mounting frame from the carrying harness of the SCR-619. Retain the six countersunk bolts.

(2) Center the mounting frame laterally about 3 inches aft of the forward edge of the deck with the long axis of the mounting frame perpendicular to the longitudinal axis of the aircraft and the battery box mounting on the left side of the aircraft.

(3) Drill holes in the deck and secure the mounting frame to the deck with the same screws which formerly held the mounting frame to the carrying harness.

(4) Cut strap slots  $1\frac{1}{2}$  inches long and  $\frac{1}{4}$  inch wide in the deck  $\frac{1}{4}$  inch outside the midpoint of the right and left sides of the mounting frame.

(5) Secure the radio and battery box to the mounting frame by the clips provided. Place a strap about 51 inches long and  $1\frac{1}{2}$  inches wide and with a buckle on one end around the radio and through

the slots in the deck. Buckle the strap and tighten it around the radio and battery box.

(6) Drill a hole in the pyralin in the top of the fuselage to permit the antenna mast to be extended through the pyralin. Install a pyralin reinforcing ring on each side of the pyralin in the upper deck to prevent cracking of the pyralin.

(7) Set the switch of the SCR-619 for 6-volt operation and connect the power cord provided to the radio and the battery box.

(8) Route headset and microphone cords up from the radio along the diagonal brace member of the fuselage to the upper right side of the fuselage above and aft of the observer. Then route the cords across the top of the fuselage to the left side of the fuselage and then forward along the left side of the fuselage to a position between the left wing butt fittings. Tie cables together and to the frame work where necessary for support.

(9) Enter notation of radio installation in Army Air Forces Form 60A.

## **2. INSTALLATION OF SCR-619 IN L-5 AIR-CRAFT.**

**a.** The SCR-619 radio is installed in the rear of the L-5 aircraft aft of the observer as shown in figures 27 and 28.

**b.** The following installation procedure is used. (See AAF Technical Order 01-50DB-21, 9 November 1945.)

(1) Remove pack board mounting frame from the carrying harness of the SCR-619.

(2) Secure the mounting frame to a plywood mounting board, AAF Part No. 45G24945, so that the longitudinal axis of the mounting frame will be

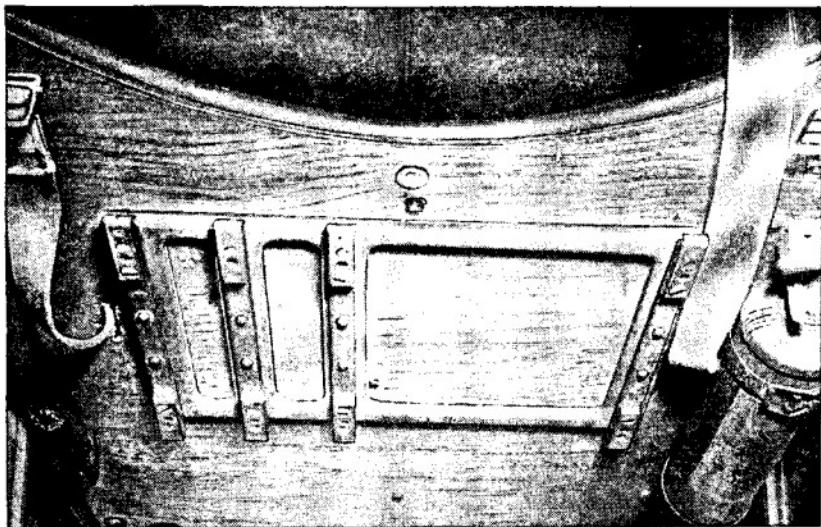


Figure 25. Installation of SCR-619 mounting frame on rear deck of L-4 aircraft.

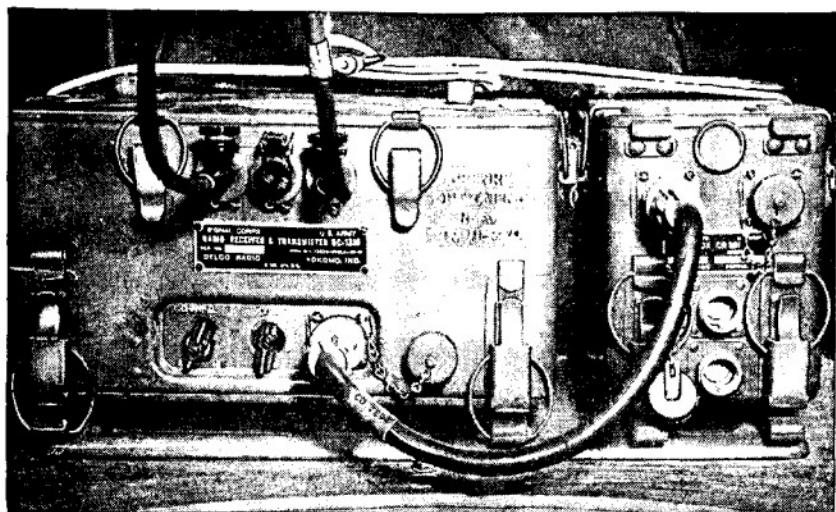


Figure 26. Installation of SCR-619 on rear deck of L-4 aircraft.

perpendicular to the longitudinal axis of the aircraft and the battery box mounting will be on the left side of the aircraft.

(3) Cut strap slots  $1\frac{1}{2}$  inches long and  $\frac{1}{4}$  inch wide in the mounting board  $\frac{1}{4}$  inch outside the mid-point of the right and left sides of the mounting frame.

(4) Remove the litter front floor assembly from the aircraft and install the mounting board on the lower longerons aft of the observer as shown in figures 27 and 28.

(5) Secure the radio to the mounting frame by the clips provided. If the aircraft does not have a 12-volt electrical system, secure the battery box to the mounting frame by the clips provided. Place a strap about 51 inches long and  $1\frac{1}{2}$  inches wide and with a buckle on one end around the radio and through the slots in the mounting board. Buckle the strap and tighten it around the radio and battery box.

(6) Install a switch plate in accordance with figure 29.

(7) Install a switch, Cutler-Hammer, AAF Part No. 8744K5, on switch plate in accordance with figure 29.

(8) Install an antenna support plate, AAF Part No. 45D24941, in accordance with figure 30. Cut a 1-inch clearance hole in the fabric in order to install the antenna mast. Install a canvas reinforcing ring, AAF Part No. 45A24942, in accordance with figure 31.

(9) Attach power cord to radio.

(10) Set the switch of the SCR-619 for 12-volt operation if the aircraft has a 12-volt electrical sys-

tem. If the aircraft does not have a 12-volt electrical system, set the switch for 6-volt operation and connect the radio power cord to the SCR-619 battery box.

(11) In L-5 aircraft having a 12-volt electrical system, route power cord forward from receiver and transmitter and fold back under mounting board. Dress power cord and microphone and headset cables along right side of fuselage along lower longeron to point aft of pilot's seat. Tie cables together and to the framework as required for support, using six of each of the following clips, AN 742-14C, AN 742-12C, AN 515-8-8, and AN 365-832.

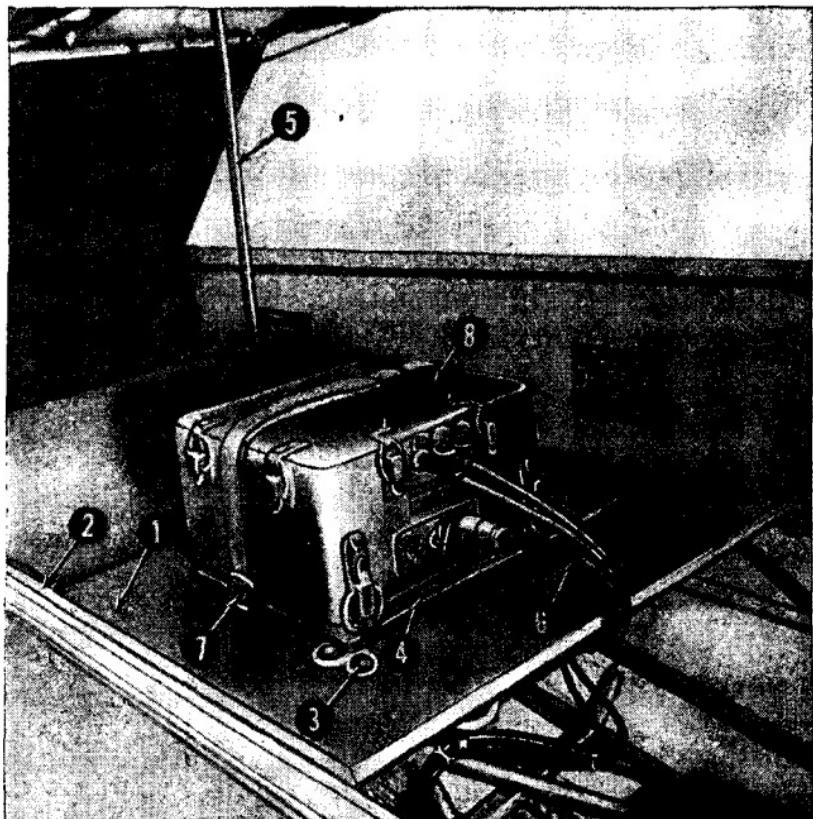
(12) Route power cord to aircraft 12-volt battery solenoid. Connect red and white wires to positive cable and green and black wires to negative terminal using two terminals, AAF Part No. AN 659-10.

(13) Route microphone and headset cords upward and across fuselage to switch panel location in accordance with figure 29. Install two clips as indicated to tie cords to existing wiring and frame members for support.

(14) Remove existing wires from terminal strip located immediately forward of switch plate. Reconnect wires to switch plate. Connect microphone and headset wires to switch and to ground using five terminals, AAF Part No. 659-2.

(15) Install cover, AAF Part No. 45D24936 on back of switch plate.

(16) Make the following entry on the aircraft wiring diagram: "For SCR-619 wiring see TO No. 01-50DB-21."

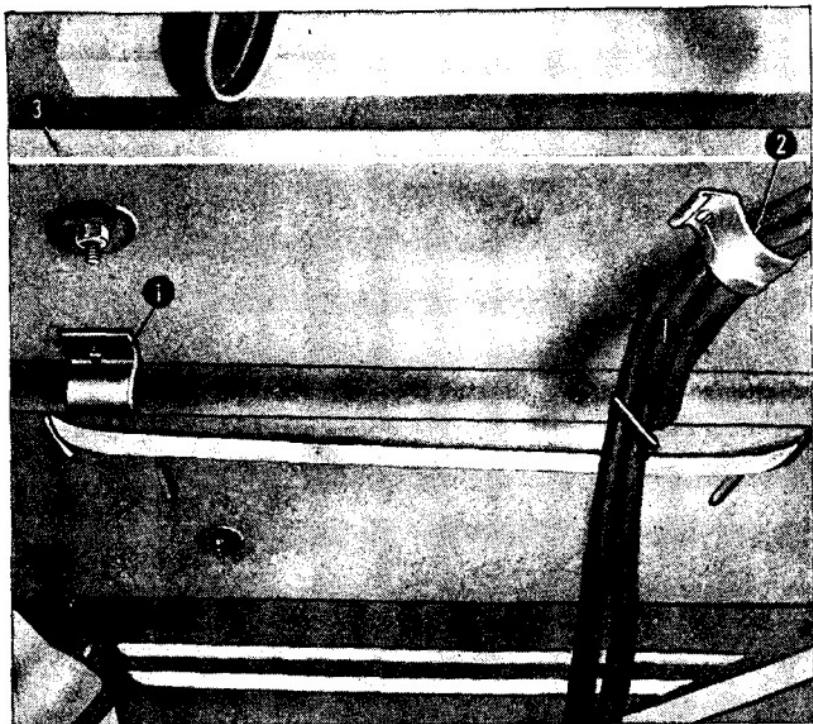


1. Board 45G24945.
2. Jig drill (#5) 2 holes through angles from board 45G24945. AN520-10-32, AN365-1032, AN970-3, 2 each required.
3. AN515-8-16, AN365-832, AN970-3, 4 each required.
4. Mounting FT-505. AN3-16A, AN365-1032, AN970-3, 6 each required.
5. Antenna.
6. Cable routing.
7. Litter strap used as safety strap.
8. Radio set SCR-619.

Figure 27. Installation of SCR-619 in an L-5E aircraft.

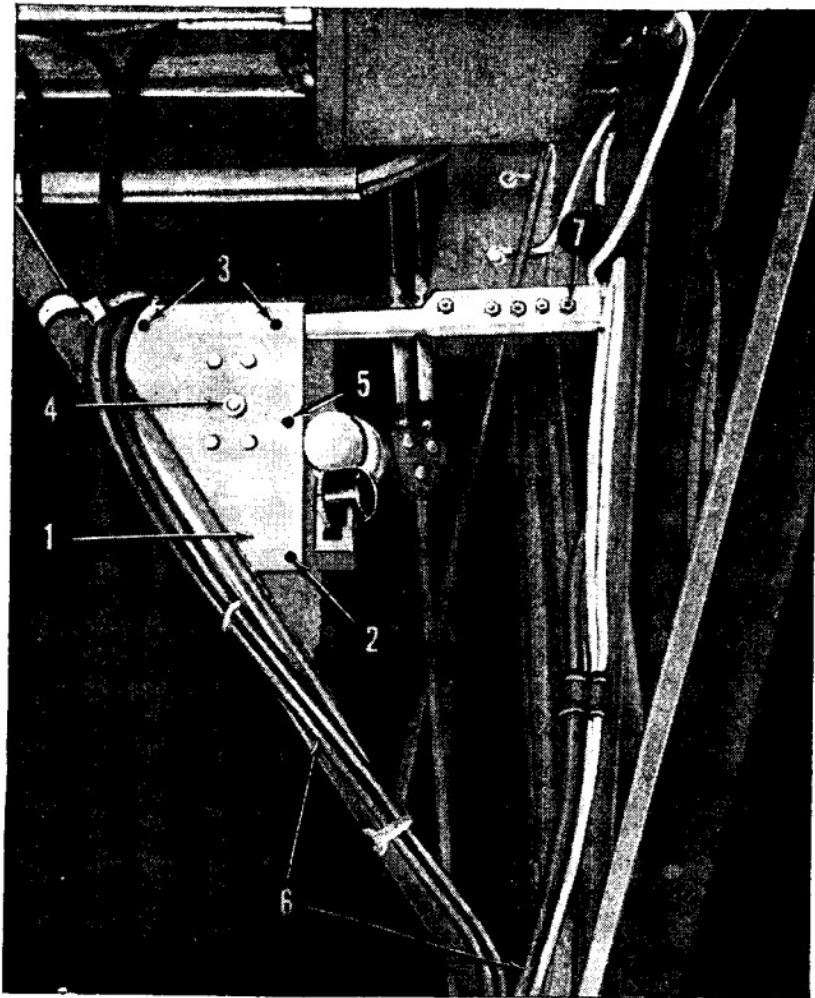
(17) Enter notation of radio installation in AAF Form 60A.

c. A Signal Corps Installation Unit, AAF Stock No. 25610-V95/50, contains all the parts necessary to accomplish the installation of the SCR-619 in an L-5 aircraft.



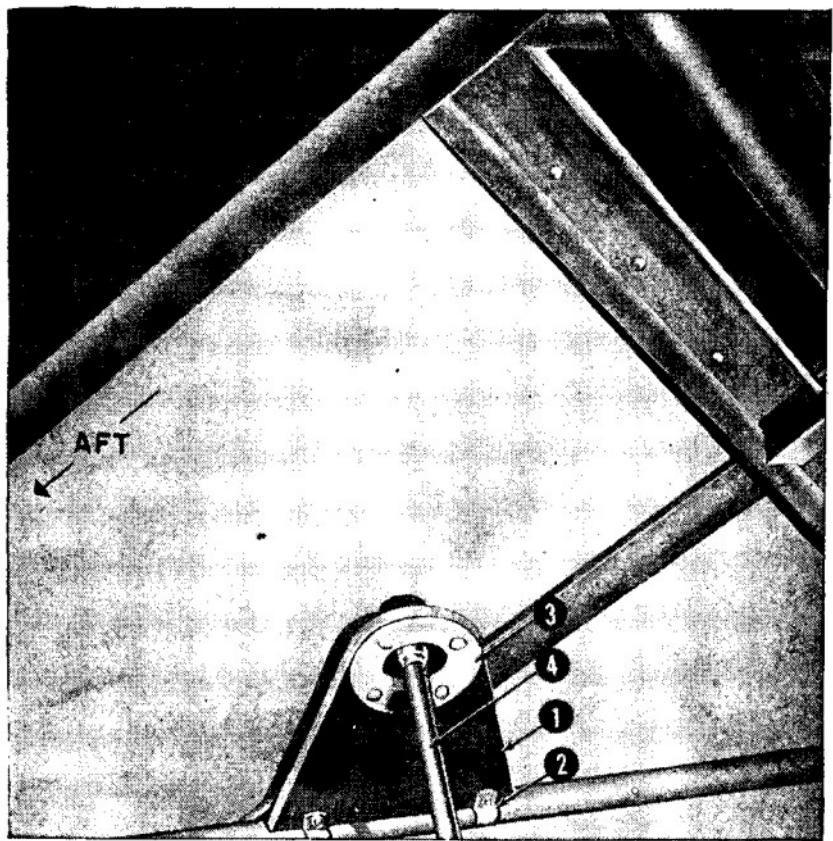
1. Clip AN750-F12, 2 each required.
2. Clip AN742-10C, Screw AN545B8-5.
3. Board 45G24945.

*Figure 28. Installation of plywood mounting board in an L-5E aircraft.*



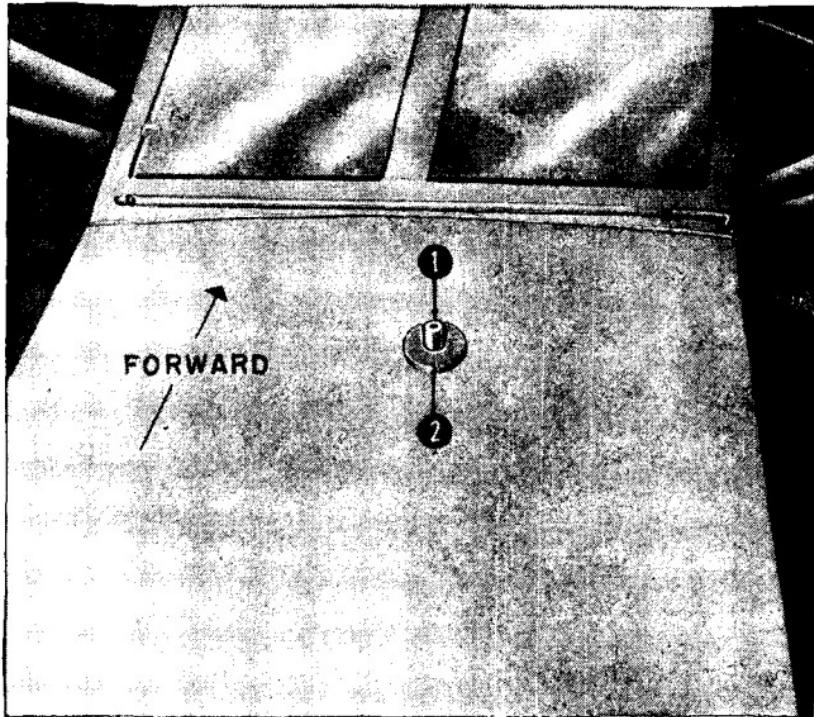
1. Plate 45B24940.
2. Jig drill (#24) 1 hole through plate from microphone bracket. AN515-6-8, AN365-632, 1 each required.
3. Jig drill (#24) 2 holes through cross member from plate 45B24940, AN515-6-16, AN365-632, 2 each required.
4. Switch 8744K5. AN515-6-6, 4 each required.
5. Drill (#24) 1 hole through plate. Locate from cover 45D24936. AN515-6-8 AN365-632, 224-3, 1 each required.
6. Cable routing.
7. Terminal strip.

Figure 29. Installation of switch plate in a L-5 aircraft.



1. Plate-antenna support 45D24941.
2. Clamp AN735-10, AN515-832, 2 each required.
3. Ring 45A24943, 2 each required; AN515-6-12, AN365-632; 4 each required, AN960D6, 8 each required.
4. Antenna.

Figure 30. Installation of an antenna support plate in an L-5E aircraft.



1. Antenna AN29-C.
2. Ring 45A24942. Locate from antenna and cut one inch clearance hole in fabric. Cement ring in place.

*Figure 31. Installation of canvas reinforcing ring in an L-5E aircraft.*

## **APPENDIX IX**

### **THE GAP CALIBRATOR AND METHODS OF OPERATION**

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Figures 32 to 36, inclusive, illustrate the gap calibrator and the various methods of using this instrument.

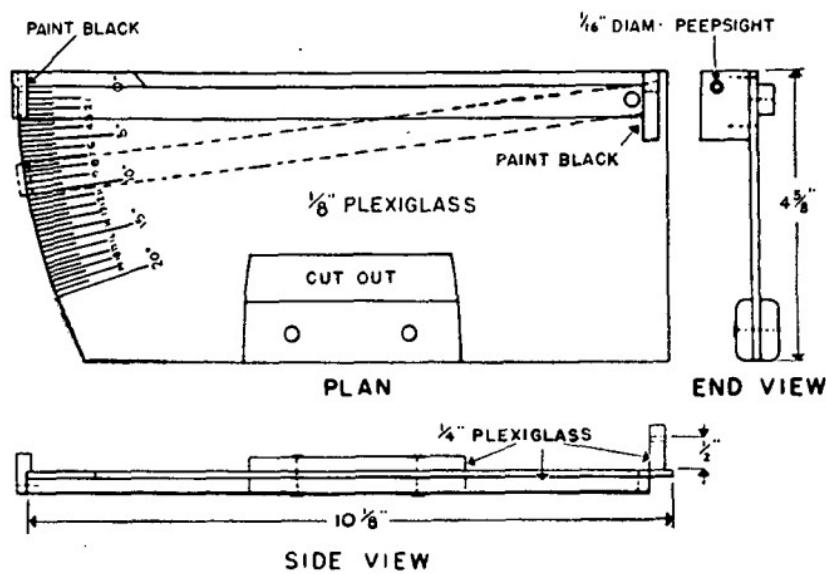
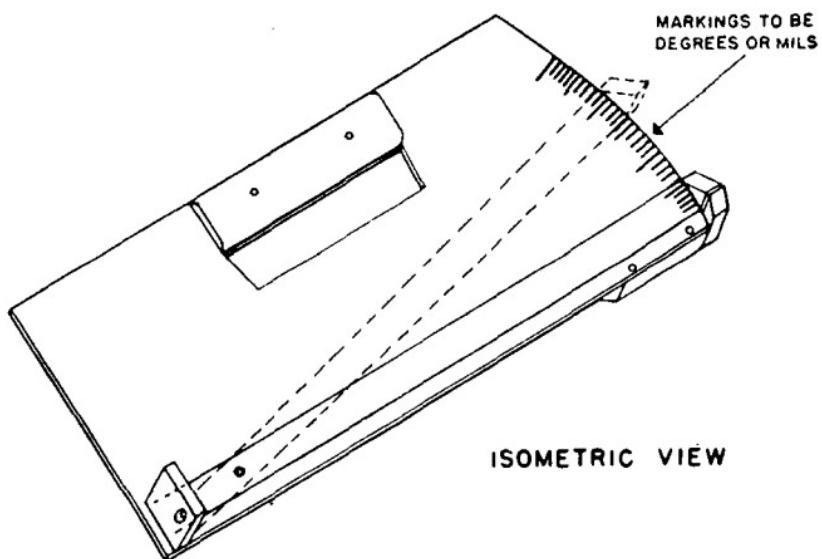


Figure 32.

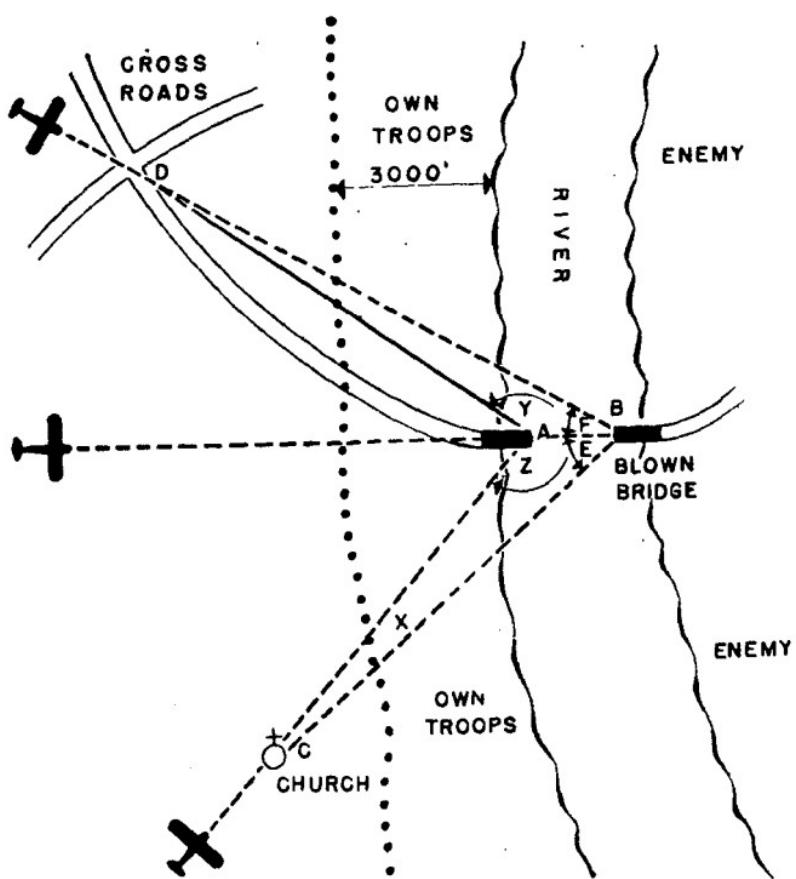


Figure 33.

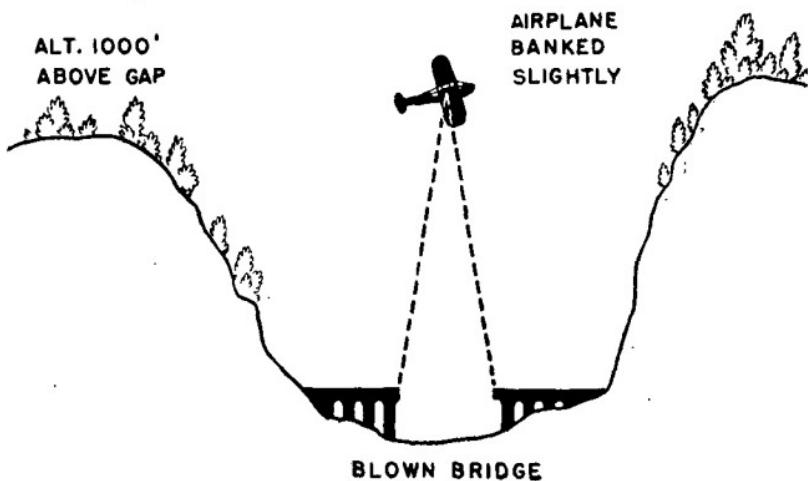
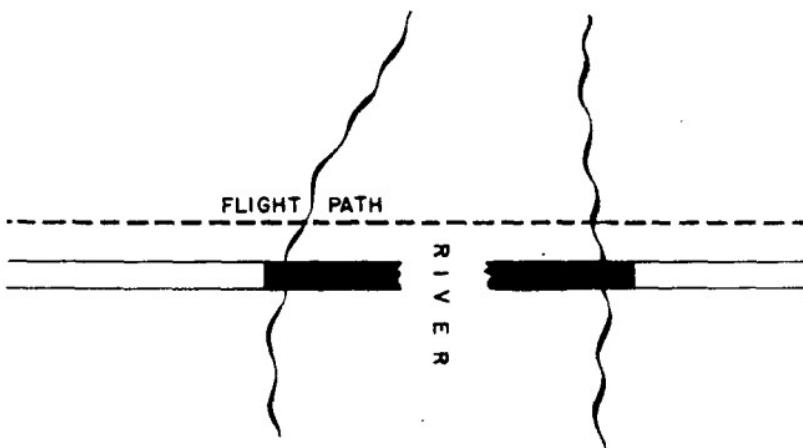


Figure 34.

**"HORIZONTAL" METHOD OF GAP MEASUREMENT**  
(WHEN AIRCRAFT CAN FLY ANYWHERE AROUND GAP)

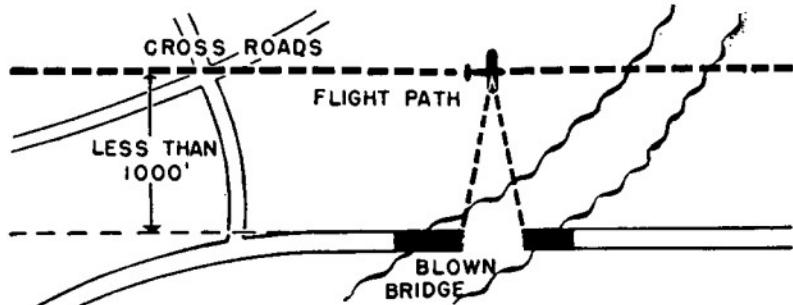
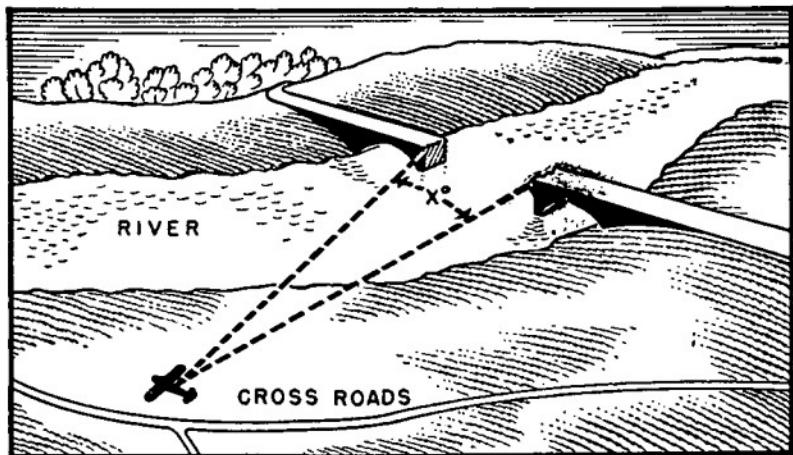
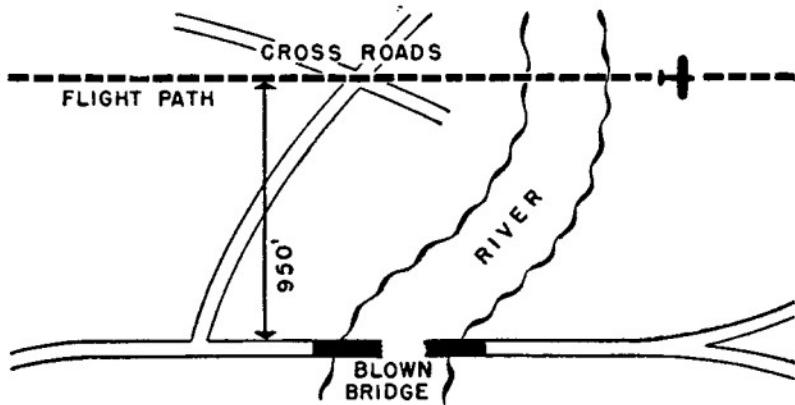
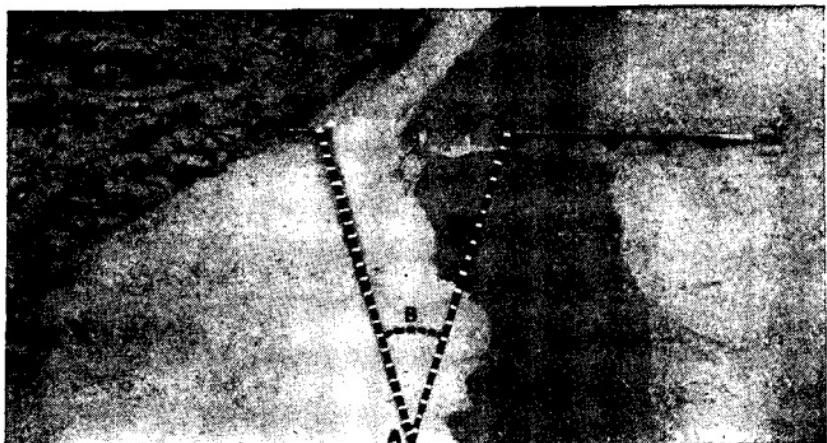


Figure 35.



A. Position of observer over a suitable landmark.

B. Angle between lines of sight of gap calibrator.

Figure 36. Typical bridge viewed by the observer during gap measurement.

## **APPENDIX X**

### **SAMPLE ENGINEER AIR RECONNAISSANCE REPORT FORMS**

---

Figures 37 to 41, inclusive, illustrate various sample engineer air reconnaissance report forms.

HEADQUARTERS  
ENGINEER COMBAT BATTALION  
A.P.O...., U. S. ARMY

Bridge Air Reconnaissance Report

1. (a) Report No..... (b) Date..... (c) Time....
2. (a) From..... (b) To.....
3. (a) Map Sheet 1/50,000 — 1/100,000 No.... (b) i MR...
4. GAP (a) WET..... (b) DRY..... (c) NATURE.....
5. WIDTH. (a) At ii WL..... (b) At BANKSEATS.....
6. BANKS. (a) Ht of near bank.... (b) Ht of far bank....  
(c) Type of Soil.....
7. Enemy action observed.
8. Approaches. (a) Near Bank.  
(b) Far Bank.
9. Parking Area.
10. Cover for building.
11. Proposed bridge.
12. Number of photos taken.
13. Remarks.\*

.....  
Signature

---

\*If part of blown bridge is to be used, describe this in "Remarks".  
Use reverse side for sketches.

Note: (i) MR = Map Reference (ii) WL = Water Line.

*Figure 37. Sample Engineer Bridge Air Reconnaissance Report Form.*

**HEADQUARTERS  
ENGINEER COMBAT BATTALION  
A.P.O...., U. S. ARMY**

## **Bridge Demolition Air Reconnaissance Report**

1. (a) Report No..... (b) Date..... (c) Time....
  2. (a) From..... (b) To.....
  3. (a) Map Sheet 1/50,000 — 1/100,000 (b) i MR.....
  4. BRIDGE. Construction (a) ii R.C.  
(b) MASONRY  
(c) STEEL  
(d) TIMBER  
(e) BRICK  
(f) Miscellaneous  
(g) No. of Arches or Openings.
  5. DIMENSIONS. (a) WIDTH (b) LENGTH  
(c) OVER. (d) HEIGHT above iii WL, RLY, Road etc.
  6. Suitable for (a) Final (b) Deferred (c) Preliminary
  7. Est. quantity of Explosives.
  8. Firing Site.
  9. Number of photos taken.
  10. Remarks.

**Signature**

Use reverse side for sketches.  
Note: (i) MR = Map Reference      (ii) RC = Reinforced Concrete  
      (iii) WL = Water Line.

*Figure 38. Sample Engineer Bridge Demolition Air Reconnaissance Report Form.*

**HEADQUARTERS  
....ENGINEER COMBAT BATTALION  
A.P.O...., U. S. ARMY**

**ROAD/RAILWAY AIR RECONNAISSANCE REPORT**

1. (a) Report No..... (b) Date.... (c) Time....
2. (a) From..... (b) To:.....
3. (a) Map Sheet 1/50,000 — 1/100,000 No.....
4. Road/Railway (a) From.... MR.... (b) To.... MR....

SHEET NO.	SERIAL NO.	M.R.	DETAIL AND DAMAGE	REMARKS

Note location of open cars containing engineer materials.  
 Use reverse side for sketches.  
 Number of photos taken.  
 Note: MR = Map Reference.

.....  
 Signature

*Figure 39. Sample Engineer Road/Railway Air Reconnaissance Report Form.*

HEADQUARTERS  
...ENGINEER COMBAT BATTALION  
A.P.O...., U. S. ARMY

AIR STRIP/FIELD RECONNAISSANCE REPORT

Date..... No.....

1. To..... 3. Map SHEET 1/50,000.....
2. From..... 4. .... Nearest Main Road Center
5. (a) Coordinates of end of runway.....  
(b) Length (Ft) .....
6. Classification of Site (overall)  
Excellent....Good....Fair....Poor....\*Reject....
7. Natural Surface Drainage  
Excellent....Good....Fair....Poor....
8. Flying Approaches  
Excellent....Average....Poor....
9. Clearing  
Light....Moderate....Excessive....
10. Aircraft Dispersal  
Unlimited....Adequate....Inadequate....
11. Access Roads  
Good....Adequate....Inadequate....
12. Number of photos taken.....
13. Remarks:

.....  
Signature

.....  
Time

Use reverse side for sketches.

\*If "Reject" classification indicated reason(s) for same will be given in Remarks column.

Figure 40. Engineer Air Strip/Field Reconnaissance Report Form.

HEADQUARTERS  
...ENGINEER COMBAT BATTALION  
A.P.O...., U. S. ARMY

Construction Materials Air Reconnaissance Report

Date.....No.....

1. To: .....
2. From: .....
3. Map Sheet 1/50,000: .....
4. Nearest Main Road Center: .....
5. Coordinates: .....
6. Description and Quantity of Materials:.....  
.....  
.....  
.....  
.....  
.....
7. Access roads:.....  
.....  
.....  
.....
8. Remarks:.....  
.....  
.....  
.....

Number of photos taken.....

Signature .....

Time .....

Use reverse side for sketches.

*Figure 41. Sample Engineer Construction Materials Air Reconnaissance Report Form.*

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